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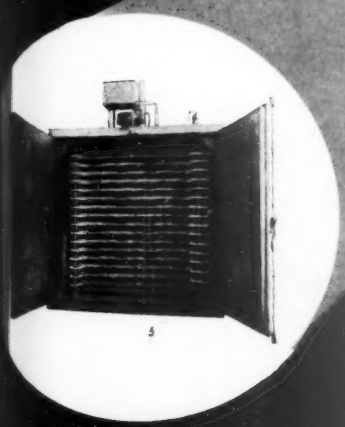
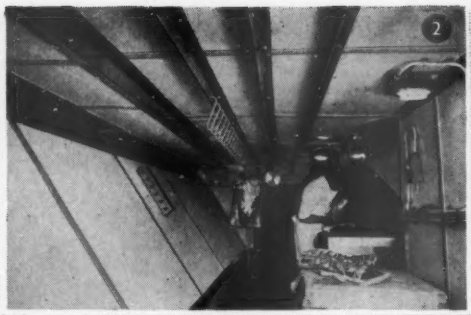


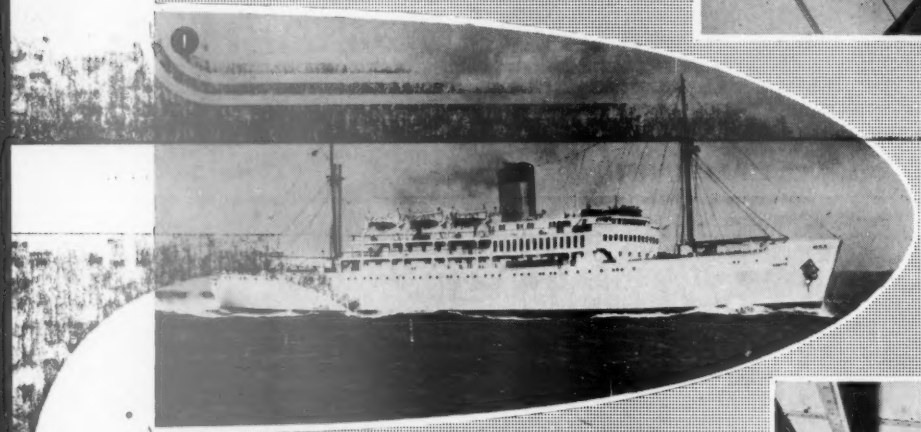
Jackstone Froster Ltd.
HUTTON ROAD GRIMSBY ENGLAND

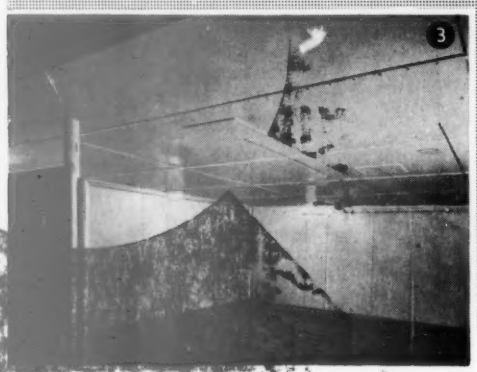
1. *The T.S.S. 'Camito', built by Alexander Stephen and Sons Ltd. for Elders and Fyffes, Ltd.*

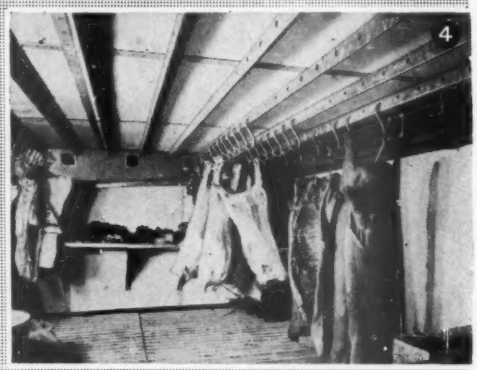
2. & 4. *'Darvic' p.v.c. sheet lines the refrigerated food compartments.*

3. *Test bay in the hold lined with 'Darvic' p.v.c. sheet mounted on plywood.*









'Darvic' was chosen for T.S.S. 'Camito'

HANDSOME MATERIAL was chosen [illegible] valuable properties. Its low [illegible] it ideal for lining refri- [illegible] is also completely odour- [illegible] drink. 'Darvic' p.v.c. [illegible] easy to keep clean. It [illegible] has high impact strength [illegible] Complete 'Darvic' interiors are now installed in some nationally known refrigerators and the applications of this versatile sheet are increasing in marine engineering.

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and Air Control News

Incorporating
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Established 1893

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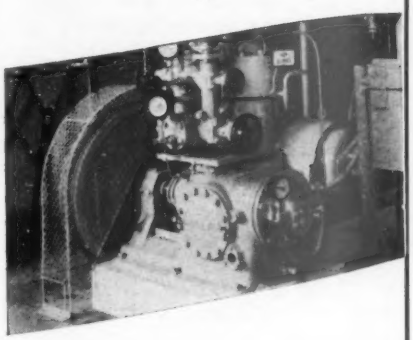

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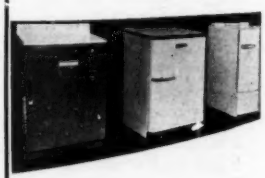

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VOLUME 61 NUMBER 720

March . 1953

Editorial . . . .

Good Showing for Fridges

Openings in Middle East

Automation in Simple Terms

● " We are made for co-operation . . . to act against one another is contrary to nature," said Antoninus. A most inspiring example of commercial liaison was to be seen at the end of last month at the Hungaria Restaurant, London, where the " top eight " refrigerator manufacturers (to use DoRDec's title) in this country staged a fine display comprising 29 models. This was a curtain-raiser to the Ideal Home Exhibition and as such gave the women's, national and trade press a valuable overall picture of the " household " industry.

● Arranged in an ascending range of internal capacity these British 'fridges made a brave showing and between the limits of 1.5 c.ft. and 9.4 c.ft. surely provide all that home and overseas buyers could wish for, in the way of quality, reliability and appearance.

● Displayed according to capacity, as stated above, these 'fridges cover every income bracket from £43 to £160. They included Astral, 1.5 c.ft. ; Electrolux, 1.7 ; Astral, 2.3 ; Electrolux, 2.4 ; Prestcold, 3.1 ; Frigidaire, 3.2 ; English Electric, 3.6 ; Hotpoint, 3.6 ; Electrolux, 3.7 ; Astral, 4 ; Prestcold, 4.3 ; Frigidaire, 4.5 ; Frigidaire (de luxe), 4.5 ; Kelvinator, 4.6 ; Kelvinator, 4.7 (export) ; Hotpoint, 5 ; Electrolux, 5 ; Prestcold, 6.1 ; G.E.C., 6.1 ; Kelvinator, 6.5 ; Electrolux, 7.6 ; G.E.C., 8.1 ; English Electric, 8.3 ; English Electric, 8.4 (de luxe) ; Kelvinator, 8.6 ; Kelvinator, 8.6 (magic cycle) ; Prestcold, 9.1 ; Frigidaire, 9.4 ; Frigidaire, 9.4 (de luxe).

● This show, which was opened by Lady Eccles, wife of the President of the Board of Trade (Lady Eccles considered that British makers built too well for she confessed she was still using a model of 1934 vintage), reflected great credit on the Domestic Refrigeration Development Committee. It was quite an experience to see refrigeration executives wearing DoRDec badges and explaining to enquirers the best points of their competitors' models.

● In the 1958 refrigerators interior fittings have been specially planned to make use of every inch of storage space while the exterior dimensions have been kept down to the minimum. Adjustable shelves help to achieve this. Some models have hinged half-shelves and flaps which are useful for holding small packets when they are in place, or allowing room for tall bottles when they are folded away. Door fittings feature very prominently this year. These hold the commodities which are most likely to be needed frequently. In the new models they include full width dairy compartments, special compartments for butter to keep it at " spreadable " temperature, shelves for bottles, racks for eggs and compartments for bacon and cheese. Some of these door fitments are also adjustable to make room for extra large bottles or packages. To keep up with the growing use of frozen foods most new models feature larger evaporators in which the packs should be kept.

● At least four of the 'fridges on display at the show had just been restyled in time for the Ideal Home Exhibition. Prestcold have what they term " the biggest small refrigerator ever." Of 3.1 c.ft. gross capacity, its external dimensions are only $33\frac{1}{2}$ in. by $20\frac{7}{8}$ in. by $18\frac{3}{4}$ in. It is very " sheer " and " squared up " and is so light that it can be hung on the wall ; it is termed the " Packaway." Kelvinator have made available on the home market their 4.7-c.ft. model which last year was available only for export while G.E.C. have come up with a very fetching frontal idea—the offering of alternative colour insets for the door handle ; these can be changed in a matter of minutes to another shade.

● In 1957, sales of domestic refrigerators reached the highest level yet, namely, 256,414. Even after this effort, Great Britain can boast only a 10 per cent. usage which has to be seen against over 90 per cent. for U.S.A. ; 84 per cent. for Canada ; Australia, 65 to 70 per cent. ; Sweden, 45 to 50 per cent. ; New Zealand, 26 per cent. ; Denmark, 25 per cent. ; West Germany, 12 to 14 per cent. ; France, 10 to 12 per cent. ; Italy, 11 per cent. to realize what an insufferable burden to the industry is purchase tax.

● The registration of companies wishing to participate in major schemes in Kuwait (one of the chief markets for British air-conditioning plant) was raised at a development board meeting which was held at the end of October. It was decided that the board should have the right to accept the registration of any company, at any time, if it should appear that such registration would be to the general benefit of the State, provided that the company should appear to be financially and technically competent to execute major projects. Any British firm wishing to tender for Kuwait Government contracts, which has not so far

registered, may now have their name put forward by their Kuwaiti associates at any time.

● J. & R. Allan, of Edinburgh, who pioneered the food hall idea in that city, have now demonstrated, over a period of a few years, the effectiveness of food hall operation. This really first-class shop makes full use of refrigerated storage and refrigerated display and has done a very great deal to promote pre-packed foods. They have been very successful with fresh packs of fish, meat and poultry and have co-operated fully with packing units in the area who supply daily packs, absolutely fresh, on a routine basis. One of the most interesting developments there has been the sale of wet fish on trays, wrapped in heat-sealed transparent paper, for which a steady and expanding trade has been developed. This food hall is also handling fresh meat on a pre-packed basis, the packs being delivered daily, with everything represented from the normal mince and steak packs to unusual items like ox tail and sheeps' heads.

● A small-scale working, automatic, production plant, turning out " tomics," will be used by the Electrical Development Association to focus attention on " Electronic control—a step towards automation," on their stand at the Instruments, Electronics and Automation Exhibition at Olympia (April 16 to 25). The " tomics " (which consists of 10 balls enclosed in a transparent tube in " tomic sequence "—one white, two black, three white and four black), has been invented to demonstrate the merits of automation. It represents an unknown product of the future, although, of course, it is the production methods which E.D.A. will be stressing—not the product. Automation is not just an automatic machine. It is a system in which somebody decides how many of a certain thing are to be made and how ; an " electronic brain," or computer, then takes over and controls the workings of machines making the various parts, so that they all work in steps to produce completed products. Each machine inspects its own work and passes satisfactory components on to the next machine and faulty components are rejected. It is to show something of this that EDA has invented this production plant.

● A number of methods of electronic control will be incorporated on the E.D.A. plant, and visitors will clearly see how these applications can be suited to a wide range of industrial processes. Photographs and display matter will call attention to the use of particular devices in factories. Light ray control will regulate the flow of balls ; a metal detector will divert metal-loaded balls ; colour sorting will be used to separate black balls from white ; a weight checker will reject those that are too heavy ; and batch counting will ensure the correct sequence. The nerve centre of the whole plant will have electronic controls with " memory " devices for holding back one operation until another has been completed ; controls for moving the rotor each time a tube is filled or emptied ; and for bringing the plant to a halt when a cycle is completed. This controller, in fact, will carry out over 480 electrical operations for every complete cycle of 10 " tomics " produced.

DOMESTIC, ELECTRICALLY-OPERATED REFRIGERATORS IN CANADA

AS a corollary to the report published in these columns in 1957, the United Kingdom Trade Commissioner Service in Canada has now published a report on the market for electrically operated refrigerators in Canada.

The main conclusions drawn by the investigators, state the Board of Trade who issued the report, are that there is a steady and continuing demand in Canada for refrigerators, which is satisfied almost entirely by domestic production and imports from the U.S.A. ; that Canadians expect similar model refrigerators to those advertised in the U.S.A. and Canadian manufacturers are, in many cases, subsidiaries of United States companies, producing refrigerators of identical design to the models being sold in that country ; that in Canada resale price maintenance is illegal, as a result of which price cutting is prevalent ; that there appears to be little prospect of United Kingdom manufacturers competing successfully in Canada against American standard models of 8 c.ft. upwards ; that a secondary demand exists for small utilitarian refrigerators for bachelor apartments, housekeeping cabins, drug stores, doctors' surgeries and basement playrooms. This has proved the best field for United Kingdom manufacturers.

Electrical equipment incorporated in refrigerators sold in Canada must satisfy the electrical code of the Canadian Standards' Association. Details of the Association's specifications are obtainable from the British Standards Institute 2, Park Street, London, W.1, who are authorized to carry out inspection of electrical appliances and equipment on behalf of the Canadian Standards Association.

(this report will be detailed next month)

Two errors occurred in the last issue relating to The Institute of Refrigeration. Lord Dudley Gordon *has already* completed two years in office and by the end of this session will have been president for *three* years. At the banquet, Mr. C. M. Brain said that £150,000 had been found by the Treasury for the National College.

60th ANNIVERSARY ISSUE

We are closing for press on March 20 with the special 60th anniversary (April) issue, so that firms who are sending historical material for inclusion in this number are asked to make every endeavour to meet this deadline.

NEWS OF THE MONTH

Refrigeration and A-c. Exports.—During January 1958 air-conditioning and refrigerating machinery (commercial and industrial sizes) to the value of £502,624 weighing 703 tons, was exported from the United Kingdom. Comparable figures for January, 1957, were 944 tons, worth £673,678.

* * *

Exports' Analysis.—Of the 703 tons of air-conditioning and refrigerating plant worth £502,624 exported by Great Britain in January—quoted in the preceding paragraph—62 tons went to the Union of South Africa, 46 tons to India, 28 tons to Australia, 25 tons to New Zealand, 47 tons to Canada, 198 tons to "other Commonwealth countries," 30 tons to Eire, 3 tons to Sweden, 25 tons to Western Germany, 25 tons to the Netherlands, 27 tons to Belgium, 6 tons to France, 16 tons to Italy, and 165 tons to "other foreign countries."

* * *

Refrigeration Plant Classified.—Of the total exports of air-conditioning and refrigerating machinery during January, quoted in the first paragraph, commercial refrigerators accounted for 132 tons, worth £80,036, industrial plant and equipment for 154 tons worth £93,761, and parts for all automatic power-operated machinery, weighing 177 tons, were valued at £120,195.

* * *

Exports of Small Refrigerators.—During January, 1,666 tons of complete refrigerators (domestic)* (including complete mechanical units) were sent overseas from Great Britain. These exports were worth £1,004,405. The 1,666 tons comprised 204 tons to the Union of South Africa, 115 tons to Rhodesia and Nyasaland, 13 tons to India, 130 tons to New Zealand, 523 tons to "other Commonwealth countries", 8 tons to Sweden, 155 tons to Western Germany, 9 tons to the Netherlands, 82 tons to Belgium, 118 tons to Italy, and 309 tons to "other foreign countries."

New Irish Fish Plant.—A new fish processing factory for the export trade has been opened at Galway docks. It is one of a series of factories to be built by An Bord Iascaigh Mhara (Irish Sea Fisheries Board) on the west coast of Ireland and has a deep-freeze capacity of 200 tons. One hundred and twenty stone of fish per hour can be processed in the plant which includes ice plant, filleting centre, stores and a trawler engine repair shop. The station can handle over 20 tons of fish per week. The factory was designed by Mr. Oscar Barry, engineering technologist of the board, and was constructed by James Stewart, Ltd., Galway. The architect was Mr. P. Beaumont.

* * *

Through Fire and Water.—Some of the meat salvaged last month from the underground cold storage rooms below the debris of Smithfield Market was found to be still fit for human consumption three weeks after the fire. It had been held in a cold room belonging to the British New Zealand Meat Company and when discovered by Mr. Austin Kingwell, a director of the company, was found to be still in a frozen state. The cold room, installed three years ago by R. E. A. Bott (Wigmore Street) Ltd., Frigidaire distributors for central London, had been out of commission since the night of the fire and surrounded by 3 ft. of water.

The burnt out section of Smithfield Market, immediately above the underground Cold Store, where frozen meat was found, three weeks after the fire, to be still fit for human consumption

**Previously, this total had included refrigerators up to 12 c.ft.*

Permission was granted for the meat to be salvaged and after inspection by Mr. F. E. Thompson, chief meat inspector for the City of London, 99 per cent. of it was passed as suitable for sale to the public.

* * *

New Abattoir for Tyneside.—It is hoped to provide Tyneside with the most up-to-date abattoir in the country. So said Councillor Ian Bransom, chairman of the central estates and markets subcommittee of Newcastle Corporation, addressing a conference to which other authorities likely to be interested had come ; these included Gateshead, Tynemouth, Jarrow, Wallsend, Whitley Bay, Blaydon, Consett, Felling, Gosforth, Hebburn, Longbenton, Newburn, Ryton, Seaton Valley, Stanley, Whickham and Castle Ward. This new municipal abattoir and by-products plant will cost between £200,000 and £250,000 and is to be built on a 22-acre site in the Paradise area of Benwell, Newcastle, to serve a population of 900,000 living on Tynside.

PICTURE OF THE MONTH

"Top Eight" was the title of the press show (an Ideal Home preview) which the Domestic Refrigeration Development Committee staged at the Hungaria Restaurant, London, last month (see p. 226). Here Mr. Morris Craig of Electrolux, vice-chairman of DoRDeC, Mr. Duncan Welch of Kelvinator, chairman of the subcommittee for the show, and Mr. Claude Simmonds, managing director, Editorial Services Ltd., who were responsible for organizing the show, welcome the Hon. Lady Eccles, wife of the President of the Board of Trade.

Importation of Natural Gas

Refrigeration makes possible long-range shipment of methane in liquid form

A contract has been signed between the Gas Council (Great Britain) and the Constock Liquid Methane Corporation of America for the experimental importation into Great Britain of liquefied natural gas by sea. A cargo ship, jointly owned by the Gas Council and the Constock Liquid Methane Corporation, is being converted and after conversion will be able to carry about 2,000 tons of liquid natural gas. It is hoped that the first shipload will arrive in the Thames within about 12 months, stated Sir Harold Smith, chairman, Gas Council, last month. If this experiment proves successful it is hoped that the way will be open, subject to Government sanction, to the importation of liquefied natural gas in bulk. The Gas Council is examining every possible way of producing gas by cheaper methods. This is one of the methods at present under review.

THERE are many parts of the world in which natural gas is found but in which there is no local demand for fuel. In these circumstances, the natural gas is either sealed off, or, where it is found in conjunction with an oil well, may be used for re-pressurizing the wells or, for reasons of safety, be burned to waste.

Since the nationalization of the gas industry in Great Britain, increasing attention has been given to the possibility of making gas from sources other than coal, or of taking natural gas into town's supply. In the past the industry in this country has been almost entirely dependent upon coal as its raw material. The bulk of the gas manufactured is still produced from coal, but the type of coal needed for carbonization is in increasing demand for other uses, while the supply is diminishing.

It was for these reasons that the Gas Council began the search for supplies of natural gas in Britain, a search which is still proceeding in conjunction with the B.P. Exploration Company. Similarly, Gas Boards in various parts of the country have entered into agreements with the National Coal Board for the purchase of methane drained from coal workings.

The liquefaction of natural gas and its transportation in the liquid form presents no easy problem, for methane, the principal constituent of natural gas, requires a temperature of $-260°$ F. for liquefaction at atmospheric pressure and the material must be maintained under these conditions during transportation. When liquefied, however, the volume of the gas is reduced to 1/600th of the space it occupies in gaseous form.

Processes for the liquefaction of gas have now been developed to an advanced state and the major portion of the technical difficulties associated with these processes has been overcome, thanks in a great degree to the development of materials capable of withstanding very low temperatures. The storage of gas when liquefied is also a process for which there is adequate precedent and technical knowledge.

What is new is the attempt to convey, by ocean-going vessel, fluids in insulated tanks at such extremely low temperatures. The success of the experiments now being undertaken by the Gas Council in conjunction with the Constock Liquid Methane Corporation will depend largely upon whether, technically and economically, this sea-borne transport has the results which are hoped for.

The gas industry in this country has, during the past three years, devoted much time and attention to study of the technical and economic aspects of importing liquid natural gas. In addition to these developments, many organizations throughout the world are engaged on similar investigations.

The Trial Shipment of Natural Gas

It is proposed to take the first trial loads of natural gas from the Gulf Coast oilfields. For the trial shipment it is proposed to use an already existing liquefaction plant which has been constructed on a barge, and which can be transported to any site in the area at which the natural gas may be loaded. This plant has a capacity of about 8 million cubic feet of natural gas a day. The liquefied gas will be stored in tanks on shore before being loaded into the vessel for shipment.

The vessel which is being converted for the trial load is a double-bottomed cargo ship about 340 ft. in length which, after conversion, will carry about 2,000 tons of liquid methane.

The liquid methane will be contained in five tanks insulated with balsa wood and their overall design and location will be such as to accommodate the effect of ship's movement at sea. As the liquid methane cargo is exceptionally light the ship will be specially ballasted.

The design and engineering work for the conversion is being handled by J. J. Henry & Co., New York marine architects, and the work is being carried out by the Alabama Dry Dock and Shipbuilding Co. Inc. at Mobile, Alabama, U.S.A.

Use in Britain

The marine terminal for the acceptance of the trial shipment in this country will be at Canvey Island on land belonging to the North Thames Gas Board and where there are suitable deep water facilities. The board is undertaking special constructional work to receive the liquid methane and the two storage tanks necessary to deal with the trial shipment are now under construction. Each tank will have a capacity of about 1,000 tons of liquid methane. The contractors for this work on behalf of the board are the Whessoe Company Limited of Darlington, and the Aluminium Plant and Vessel Company Limited of Crawley, and the design of the tanks has been determined by the board in conjunction with these two firms.

The liquid natural gas will be pumped from the cargo tanks on the vessel to the shore storage tanks by specially designed ships' pumps through a pipeline with a 6 in. covering of insulation. Although these shore storage tanks are heavily insulated there will be a continuous boil-off of gaseous methane from the liquid and this material will be contained in a small gasholder of the dry-sealed Wiggins type, whence it will be pumped into the mains system. Liquid methane will be vaporized by heat exchange with water or steam and there is no intention at this stage of making use of the cold content or the refrigerating capacity of the methane. The liquid methane will be converted to gas under pressure and this pressure will be used to convey the gaseous methane into the board's transmission lines. A new transmission line is being laid from Canvey Island to connect with a high-pressure main already in existence between Shellhaven and Romford Works and the gaseous methane will mix with refinery gases from the Shellhaven refinery.

The town's gas supplied in the North Thames Gas Board is distributed at 500 B.t.u. per c.ft. while the methane has a calorific value of 1,000 B.t.u. per c.ft., and transformation of the methane into gas of 500 B.t.u. per c.ft. will be carried out at Romford by the Onia-Gegi catalytic process.

The gas after transformation will have similar characteristics to gas normally produced from coal and will be suitable in every way for consumers' appliances with the added advantage that it will be free from sulphur.

Correspondence

To the Editor,

MODERN REFRIGERATION,
London, S.E.1.

Thermal Conductivity of Liquid Refrigerants

Sir,—In December, 1956, MODERN REFRIGERATION published a paper of mine entitled " Need for revision of accepted thermal conductivity values of certain refrigerants "[1] which suggested that the data of Markwood and Benning[2] for liquid " Freons " were high by the order of 20 per cent. The issue for December, 1957, contains a paper by B. R. Malhotra, B.E., on " Thermal conductivity of liquid refrigerants,"[3] which reports one new value, that of 0.905 B.t.u. in./ft^2 hr °F (0.001295 J cm./cm.^{2} sec. °C.) at 27° F. (–2.8° C.) for " Freon 11," monofluorotrichloromethane. He states that this value is within 10 per cent. of Markwood and Benning's data but indicates that, if the view of the N.P.L. (my aforementioned paper) is accepted the result may be as much as 30 to 35 per cent. too high. For this he finds no explanation. Criticism of Markwood and Benning's values had previously been made by Riedel[4] and by Cherneyeva[5], and has been supported by the results of measurements recently undertaken in the Physics Division of the National Physical Laboratory. The guarded hot-plate apparatus[6] has been adapted and thermal conductivity determinations are nearing completion on several " Freons " over the range 20° to –30° C., the liquid film being about 0.3 cm. thick.

For " Freon 11 " our results indicate a value at 27° F. (–2.8° C.) of 0.713 B.t.u. in./ft.^{2} hr. ° F. (0.00102 J cm./cm.^{2} sec. ° C.). This value is in

close agreement with that of Cherneyeva[5], whereas the new value of Malhotra is about 27 per cent. greater and Markham and Benning's value about 17 per cent. greater.

Malhotra, in discussing his results, says "It cannot be claimed that the results obtained with different liquids during the course of the experiment are very reliable, but they do indicate that with certain improvements a thick layer apparatus is as good a possibility as the thin one."

In my opinion there are several likely sources of error with this apparatus. One that has not been mentioned is that the Perspex ring, projecting downwards into the liquid, will disturb the temperature distribution owing to its higher thermal conductivity, and consequent convection may become a serious factor with liquids of low conductivity. The suggested replacement of the Perspex by Pyrex would tend to increase the trouble rather than lead to improved conditions.

The work once more shows the difficulties attendant on the use of thick layers for thermal conductivity measurements on poorly conducting liquids.

The measurements referred to formed part of the research programme of the National Physical Laboratory and were undertaken with the assistance of Mr. A. R. Challoner.

This letter is published with the approval of the Director of the Laboratory.

Yours, etc.,

R. W. POWELL,
National Physical Laboratory,
Teddington.

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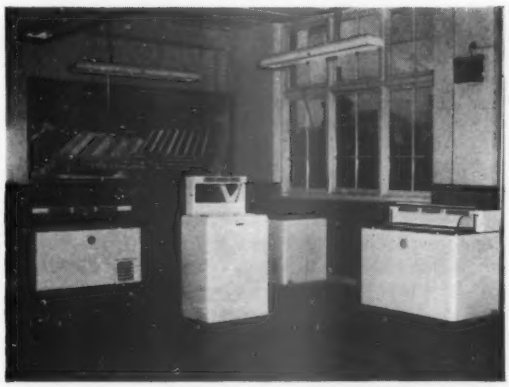
[6] CHALLONER, A. R., & POWELL, R. W. (1956). *Proceedings Royal Society A*. **238.** 90.

STERNE'S NEW LONDON OFFICES

TO have succeeded in placing under one roof in the London area their offices, showrooms and servicing facilities is something of a triumph for L. Sterne & Co. Ltd. in view of the present difficulty of securing premises in the metropolis.

A corner of one of the general office floors.

The well-illuminated drawing office.



A corner of the showroom photographed before the display had been completed.

After having their offices located at Palace Chambers, Bridge Street, Westminster, for 15 years, and their servicing staff and equipment at Upper Thames Street, E.C.4, for the same period, Sterne's felt the need for centralization of all their operations.

By a happy chance the very ample building occupied by Messrs. Barnes, piano manufacturers, fell vacant and it is into these premises that Sterne's have now moved so conveniently.

The four-storey building needed considerable adaptation before being suited to the new owner's needs but this has been carried through with only negligible interruption of day-to-day operation. The ground and mezzanine floors now serve as the service depot and stores, while the first and second floors contain extremely light and airy offices. The top floor is given over to repairs to and rebuilding of cabinets and units. The 30-cwt. lift, originally installed for conveying pianos, is ideal for its new use. A rebuilt garage houses stores and forms also the welding shop. This accommodation, without the adjacent single-storey structure, provides 22,000 c.ft. of floor space.

Sterne's London staff numbers 50 persons, in addition to which there are 65 personnel outside, mainly connected with servicing.

The new premises are located at 36-38, Peckham Road, London, S.E.5 (RODney 6300) which is only fifteen minutes' run by car from the centre of London.

Immersion Freezing of Poultry

A subject of growing importance to U.K. industry

AT the 44th semi-annual meeting of The American Society of Refrigerating Engineers held recently in Chicago, Mr. E. L. Hulland of Swift and Company, famous packers in that city, read a paper on the above subject. This topic is exercising the minds of many persons in the poultry trade in this country.

"Immersion freezing involves direct contact with a refrigerated liquid. Immersion freezing takes advantage of the rate of heat transfer from a solid to a liquid to obtain a fast freeze without resorting to extremely low temperatures," said Mr. Hulland.

"The increasing popularity of frozen foods of all kinds, together with the rapid growth of facilities

for distributing frozen foods in retail stores puts frozen poultry, and especially frozen turkeys, on display. Appearance has become important.

"One way to get the desired white or yellowish-white appearance is by using low air temperatures and high air velocities—in other words, blast freezers. These are expensive, both to build and to operate. In the search for a less costly way the old idea of freezing by direct application of refrigerated brine has been revived, but with the economic odds in its favour.

"Immersion freezing as we know it today is most generally used for turkeys and this discussion applies specifically to turkeys, although the same principles would apply to other types of poultry.

"There are several concerns currently building immersion freezing equipment, but all operate on the same general principles. After eviscerating and chilling to 40° F. or lower the birds are put into individual plastics bags. By some means, such as partial evacuation and shrinking, the bag is drawn very tightly over the bird. This is essential to the process since any air space between the bag and the bird slows down the freezing. The sealed plastics bag prevents the brine from entering the body cavity or coming in contact with the bird.

"After bagging, the birds are placed in a shallow tank and float through the tank in the refrigerated liquid. Because of their shape they float breast down, with the back above the surface. A system of sprays covers the top of the tank, and brine is continually sprayed on the birds as they float through. Pumps circulate the brine from one end of the tank to the other to carry the birds through the tank. At the outlet end a conveyor removes the birds. The speed of this is adjustable to control the length of time in the tank.

"After leaving the tank the birds are rinsed off by a water spray and are then boxed and placed in the storage freezer. Thus we have a continuous process, requiring a minimum of labour.

"Choice of the liquid to be used in the freezing process is rather limited. It must be non-toxic and should not impart any undesirable flavour, because even though the turkeys are enclosed in a waterproof bag, there is always the possibility of leaks. Secondly, it must not freeze at the desired temperature. The two liquids commonly used at present are propylene glycol and salt brine.

"Selection between these two is governed by the temperature desired in the tank, salt brine being used down to about zero, and propylene glycol for lower temperatures. There seem to be two schools of thought regarding the most desirable temperature: one holds that temperatures should be well below 0° F.. −20° F. or lower; the other maintains that 0 to +5° F. is satisfactory. At the moment this second school seems to be growing in favour.

"Propylene glycol becomes somewhat viscous at low temperatures, at least as compared to salt brine, with the result that the heat transfer rate is not quite so rapid. In fact, some recent tests have indicated that turkeys freeze just about as fast at 0° F. in brine as at −20° F. in propylene glycol. Also, these tanks hold large quantities and the cost of the propylene glycol to fill one becomes quite an item.

"Turkeys remain in the tank from 30 to 90 minutes, depending upon the brine used, temperature, and freezer facilities available for finishing the freeze. About ⅓ to ½ of the actual freezing is done in the tank and the balance in the storage freezer. There is no apparent difference in quality between birds so frozen and those completely frozen in the brine tank.

"Concerning tank size, the turkeys float through in a single layer and on the average require about ¾ of a sq. ft. of tank area/turkey. Thus, 400 turkeys require a tank area of about 300 sq. ft. There has been no standardization of tank sizes as yet and each is almost a custom job to suit volume desired and space available.

"In figuring the refrigeration requirements for one of these systems the big problem is to determine the product load. Since the turkeys are only partially frozen in the tank, the weight of turkeys passing through the tank per hr. has no direct relation to the weight frozen per hr. Fortunately, the freezing proceeds from the surface in and at a relatively constant rate, regardless of the size of the turkeys. For example, with salt brine at 5° F. they will freeze to a depth of about ¾ in. in 30 minutes, whether they be light Beltsvilles or heavy bronze toms. When ready for freezing they are fairly symmetrical and the area and hence the volume frozen per bird can be calculated with a fair degree of accuracy. From this the heat load per bird and the hourly product load can be figured. It is advisable to figure this for various sizes and production rates and use the highest product load so determined in sizing the brine cooler and compressor. Heat load from the tank itself, pumps, piping, and so forth are figured in the usual manner and added to the product load.

"Brine may be refrigerated either by a shell and tube cooler or by pipe coils in the bottom of the tank. The shell and tube cooler permits the use of a shallower tank, thus reducing the amount of brine in the system and is possibly a little lower in cost. However, it is more likely to be damaged by a freeze-up. It is most generally used with propylene glycol systems. With salt brine the pipe coil is more common as it cannot be damaged

(*Continued on page 266*)

This contemporary-style building is the administrative block and is only a small portion of the whole premises.

Refrigeration Plant in a Food Processing Factory

Kraft Foods Ltd. move north to vast new premises

IN 1926, the Kraft undertaking of America established a selling organization in the United Kingdom. At the premises in Hayes, Middlesex, only food products of U.S. origin were at first handled. As time went by, local manufacture of a wider and wider range of commodities was carried on until the complete group of famous Kraft lines became British made.

In the autumn of 1956 it was decided that the existing premises were no longer suitable to cope with the expanding market ; the export side of the business, particularly to such regions as Africa and the Middle East, had grown enormously since World War II.

A choice of four industrial sites was offered by the authorities concerned and Liverpool was selected, having regard to its suitability for the import of raw materials and the export of finished products, and to the availability of the right kind of labour.

In the latter half of 1957 the new building went into production and the owners are satisfied that they have the most modern and efficient food factory in Europe.

Based on a floor area of 300,000 sq. ft., the new building, which cost £2,000,000 when equipped, is a single storey, windowless structure, that has been designed to allow the fullest use of fork lift trucks. Great spaciousness is everywhere evident and ceilings are 19 ft. high in most sections.

The four main groups of food produced by Kraft are : margarine, processed cheese, natural cheese and bottled lines such as salad cream.

The extensive refrigeration plant in this factory, made and installed by L. Sterne & Co. Ltd., for dealing with particular processing operations, for the air-conditioning of certain spaces and for the cold storage of raw materials and finished products absorbs 500 h.p.

The refrigerating machinery comprises :—

2—4W $7\frac{1}{4}$ 110-h.p. straight compression machines on a 17° F. suction main working

on air-conditioned rooms and general duty 35° F. cold rooms ;

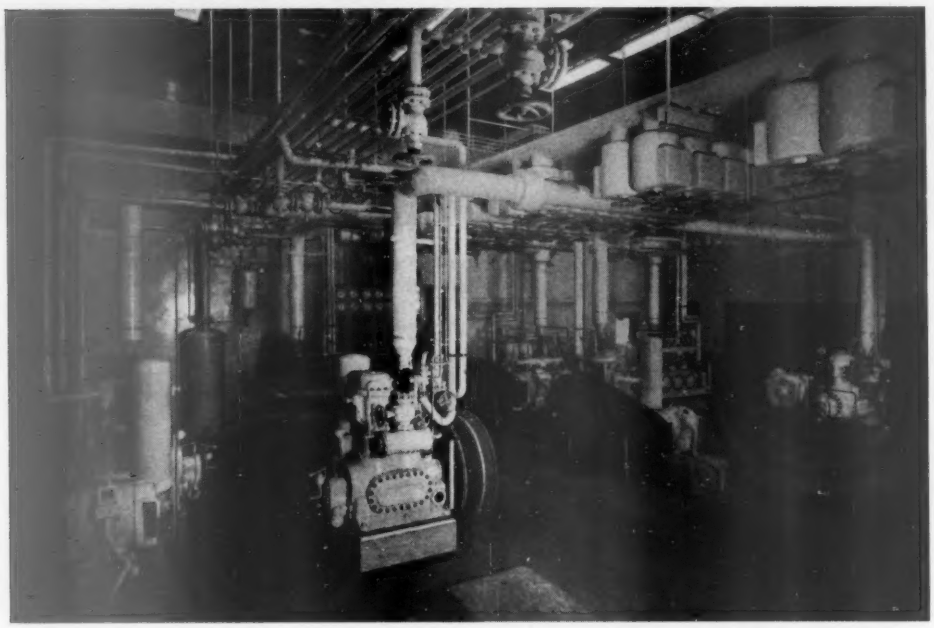
1—2 MAC 35-h.p. compound compression machine on a –1° F. suction main serving butter and egg rooms at 10° F.

3—3 MAC 55-h.p. compound compression machines on a –17° F. suction main working on kombinators.

1—3 MA 80-h.p. straight compression machine on 17° F. suction main dealing with the sliced cheese section.

the total condensing duty in a common discharge main. Both sets are automatically controlled by H.P. switches ; these switches allow manual adjustment for summer and winter settings.

The jacket water in each machine is controlled by a magnetic valve wired with its stator. The jacket water is fed to the evaporative condensers, to be used as make-up water. The condensers are also fitted with ball valves so that make-up water can supplement the jacket water when necessary.



A general view of the machine hall.

All these compressors are fitted with unloading devices and are driven by high torque squirrel cage motors with specially designed rotors so that the power surge when switched direct in line is kept to three to four and a half times full load torque.

All compressors are valved to the four suction mains so that there is complete interchangeability and all machines have hand-operated duty reduction valves ; the compound machines can work on high-temperature mains without overloading the motors.

Automatic control is adopted for all the compressors by means of pressure switches on their respective suction mains, with time-delay arrangements to prevent cycling.

The plant is equipped with two banks of forced draught condensers, each handling 50 per cent. of

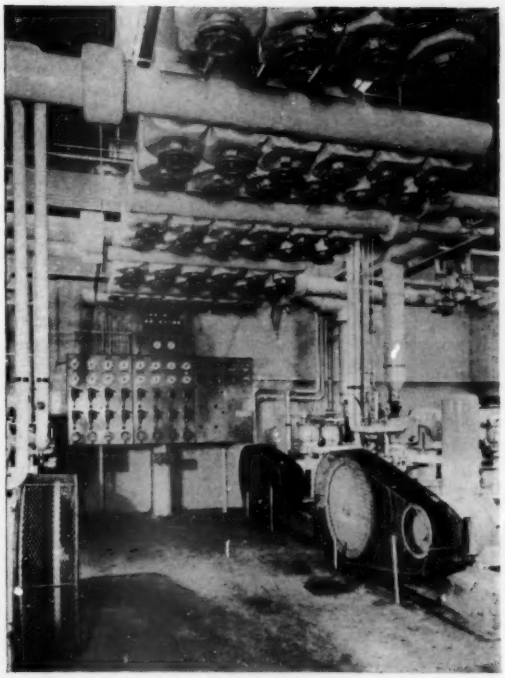
Some existing shell and tube condensers were fitted in parallel to the two evaporative condensers, the former being complete with automatic, pressure-operated water valves controlled by discharge gas pressure. These condensers act as a cushion should very hot periods occur and the discharge pressure rises above an economic maximum.

On three of the four temperature suction mains a 3 ft. 1¼ in. by 8 ft. high suction trap has been fitted, incorporating an internal liquid sub-cooling coil with by-pass connexions and remote level gauges with high-level alarm.

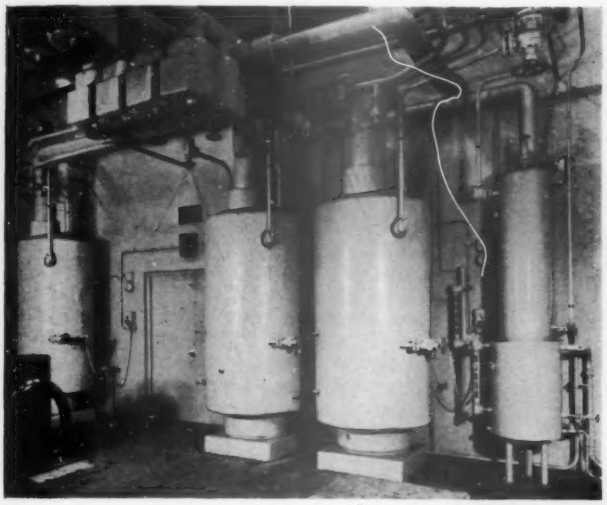
An oil rectifier has been installed, connected to the oil separator suction traps, etc., complete with hot-water supply and level gauge.

The plant also includes an automatic non-condensible gas purger.

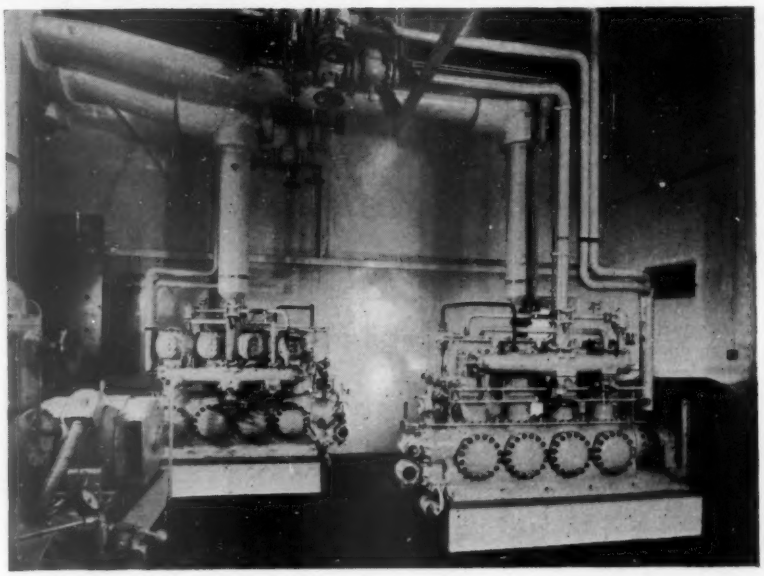
All the cold rooms have been fitted with floor mounted air coolers, with centrifugal fan sets v-belt driven, these coolers having high-level discharge nozzles. The coolers in the 35° F. general storage rooms have finned elements and those in the 10° F. butter and egg chambers have plain pipe elements, all these units incorporating water defrosting arrangements. All coolers have been fitted with H.P. float control and magnetic liquid valves operated by the room thermostats, the fans running continuously.



Gauge panel in compressor room.



Suction traps and oil rectifier.



Mark 4W7½ compressors showing revised arrangement of off-loaders and connexions.

Setting the Style in Sutton Coldfield

CHAMBERLAIN'S new shop in Sutton Coldfield demonstrates in a convincing way how contemporary décor can give sales-impact to relatively mundane products like frozen foods, fish and poultry. A feeling of cleanness and airy lightness is achieved by full-length windows at the shop-front, while the lights are recessed into a midnight-blue ceiling.

The atmosphere of hygiene is strengthened by the sight of the Prestcold refrigerated display cases on either side of the shop. Two Prestcold "Farmoors" present a mouth-watering display of frozen foods, and the 8-ft. Prestcold Parade display case sets off to great effect prime ducklings and other wrapped poultry. These two displays flank the special serve-over fish slab. " When I asked Refrigeration (B'ham) to install these display cases," says Mr. Arthur Chamberlain, " my idea was not only to give the new shop an attractively contemporary appearance but to sell fish, meat and poultry by presenting it to its very best advantage in an hygienic way. And this hygiene isn't just ' surface ' either—there's 525 c.ft. of space in the ' Amara ' cold-room at the back of the shop, which provides ample storage space for all our goods."

Judging by the response of Sutton Coldfield's housewives, Mr. Chamberlain's bold experiment in providing the " shop of the future—to-day," certainly seems to be paying dividends.

★

Refrigeration Controls—3

PRESSURE-OPERATED TYPES

By H. H. EGGINTON

(*Continued from February issue*)

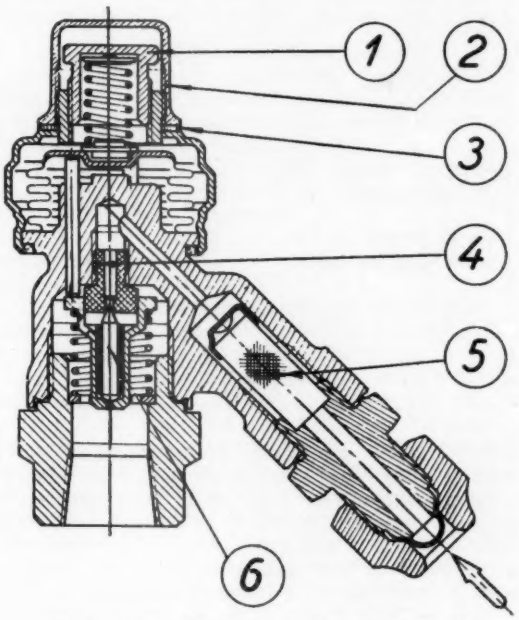
Constant Pressure Expansion Valves

THESE valves are simply pressure governors where the downstream pressure operates against a bellows or diaphragm which is opposed by a spring, and the changes in pressure in the evaporator circuit merely open or close the valve. It will be evident that on a given setting some pressure change must take place and therefore some pressure and temperature swing must occur on the evaporator, because a change in pressure is necessary to produce work to open or close the valve assembly. Usually a 4 lb. per sq. in. change is used to rate a constant pressure expansion valve because this is considered to be a reasonable pressure or temperature change in the evaporator and can, therefore, be used for rating the capacity of the valve. Capacities in excess of the rating can be obtained if the permissible variation of pressure in the evaporator can be extended from 4 lb. per sq. in. as long as an unacceptable swing in evaporation conditions is not obtained.

It will be appreciated that the capacity of a valve for given condensing and evaporator pressures, *i.e.*, pressure drop across the valve, is a combination of the orifice valve size and also of the pressure system rate of the mechanism, in other words, the amount by which the valve can be opened for a unit of pressure change.

It cannot be emphasized too strongly that comparing valves by orifice size alone is unreliable, because the flow of refrigerant is a combination of the orifice size and the amount of opening of the valve. This latter factor is controlled by the pressure system rate which, as previously shown, can be resolved from the effective area of the prime mover, the pressure operating on it, and the sum of the rates of the prime mover and springs. Such calculations give answers in terms of lb. per sq. in. per in., *i.e.*, movement of the valve needle for a lb. per sq. in. change in pressure (see fig. 4 and 5).

Apart from this, the capacity which is effected by a constant pressure expansion valve is a direct relationship of the pumping capacity of the compressor because the valve is specifically designed to, and in fact must, meter refrigerant in direct proportion to the compressor requirement according to the specific pressure required in the evaporator. This state of affairs is in balance until the valve is fitted to a compressor which can demand more refrigerant for a given evaporator pressure condition than the valve can supply in its fully open



By courtesy of Danfoss Manufacturing Company, Denmark.

Fig. 4.

1. **Regulating knob.**
2. **Seal Cap.**
3. **Rubber gasket.**
4. **Orifice.**
5. **Strainer.**
6. **Needle.**

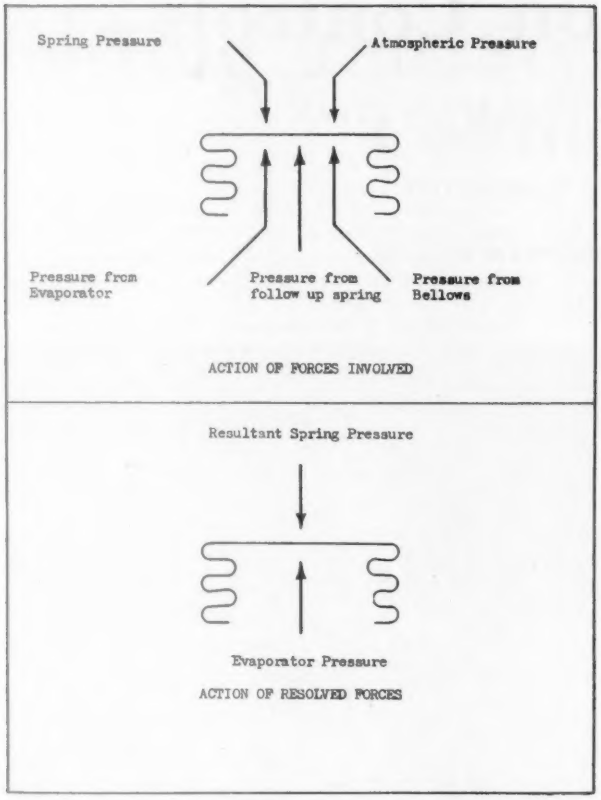


Fig. 5.—Constant pressure expansion valve—balance of forces.

condition. A valve must be selected, therefore, which is capable of metering refrigerant to satisfy a given compressor size with an evaporator pressure change of the order of 4 p.s.i. Usually both compressor and valve are rated in terms of B.t.u. per hour for given condensing and evaporating conditions on a specific refrigerant.

Principal Requirements

(1) The construction of constant pressure valves should be such that they are not erratic and particularly that they are not so in relation to ice or moisture depositing on the prime mover. This is primarily a problem of sealing.

(2) The valve seat area on which the condensing pressure is operative should be small in relation to the prime mover area on which the evaporator pressure is operative. If this is not so, change in condenser pressure will alter the evaporator control pressure.

(3) A valve should have a low operating differential, in other words, a low valve hysteresis ; certainly the valve should be capable of changing direction of movement with a pressure change of not greater than 1 p.s.i.

(4) A valve should have a good range of adjustment, preferably able to control from 20 in. mercury vacuum to 35 p.s.i. as one primary range of valve requirement, with a subsequent valve capable of going up to 75 p.s.i. the latter being useful for the higher pressure refrigerants.

(5) The valve mechanism must have good shut-off characteristics so that when the compressor stops, leak of refrigerant to the evaporator does not occur.

Constructional Details

Constructional details vary very little from one manufactured type of constant pressure valve to another and, ignoring the ammonia type, are mainly brass-bodied valves with stainless steel needle and seat orifices, or agate and plastic. Prime movers are usually brass bellows or stainless steel diaphragms. The ammonia types vary slightly, inasmuch as cast iron and steel construction is used in place of non-ferrous alloys with the possible exception of monel, which is occasionally used for seat and diaphragm material. Secondary orifices are usually fitted on the outlet of ammonia-type valves to reduce the pressure drop across the controlling needle and orifice in an attempt to eliminate the danger of icing up and separation of wax. This also tends to minimize needle and seat wear due to erosion.

Operating Characteristics

These are as follows :—

(1) Constant evaporating temperature.

(2) High initial superheat at commencement of pull-down.

These characteristics give a specific type of control, such that when the compressor is switched on the evaporator is not used efficiently and the bulk of it is superheating the vapour. This is because the valve is set to control at given pressure and the heat load is high on starting the machine. The suction of the compressor causes the valve to open and admit refrigerant, but this is quickly " boiled off " due to the heat load in the first part

of the evaporator ; hence the pressure rises and the valve closes. The bulk of the evaporator then further heats the vapour, *i.e.* is used for superheating.

It is these characteristics which give the constant pressure valve specific advantages and disadvantages and hence define its useful field of application.

Advantages

(1) The constant evaporating temperature is useful in applications where a drop in temperature below a certain value will cause damage. This is particularly so in water-cooling applications.

(2) The constant evaporating pressure means that overload conditions on the motor are less likely to occur and the power of the motor can be selected accordingly. In units where thermostatic expansion valves are used it is sometimes necessary to provide a motor to meet the higher load conditions during the early stages of pull-down.

Disadvantages

(1) As the valve delivers a certain quantity of refrigerant which remains nearly constant the evaporator will only be partially used when the refrigerated space is warm. As the temperature of the room drops, more and more of the evaporator surface will be required to boil the refrigerant. This means that the evaporator is not being used efficiently for the whole time when the plant is running and consequently the time required to pull a given space down to temperature will be much greater than that if a thermostatic expansion valve is used.

(2) As condensing units extract more heat when the evaporator is working at relatively high temperatures the constant evaporating temperature means that the unit is working less efficiently and this is a further cause of slower pull-down.

(3) The valve relies upon a certain heat input into the evaporator to boil off the refrigerant and obtain a safe value of superheat in its final condition. If this heat input is decreased due to one of the following reasons there is a danger of liquid refrigerant entering the compressor :—

(*a*) If excessive frosting of the evaporator occurs, this will reduce the heat transfer capacity of the evaporator and all the liquid will not be vaporized.

(*b*) If the valve is set too high for the thermostat setting, the throttling range and hence valve opening at the balance condition will be such that too much liquid passes through the orifice and enters the compressor.

It will be appreciated that with a constant pressure type control it is essential to avoid flooding of the liquid refrigerant to the compressor. This is achieved by adjusting the valve such that the flow of liquid is balanced with the minimum heat load on the equipment, or by fitting a thermostatic switch, the sensitive feeler of which is attached to the end of the evaporator.

Pressure controls should never be used on a plant operating with constant pressure expansion valves and thermostats should always be used for temperature control, by stopping and starting the compressor machinery.

Because of the danger of liquid entering the compressor, the setting of the thermostat sensing the temperature of the evaporator (and hence the pressure in it) and the valve controlling the pressure of the evaporator, should always be reasonably close. Setting the thermostat low without altering the valve may cause liquid to enter the compressor, as may a thermostat which fails to cut out on fall of temperature.

Valve Applications

It is important to realize that the constant pressure valve has uses intermediate between the capillary restrictor used on the hermetic machine and the thermostatic expansion valve.

The application of each of these types of metering devices is in accordance with the primary requirement of the plant, for example :—

(1) Capillary tube—used where the working temperature range and the thermal load are both reasonably constant.

(2) Constant pressure valve—used where adjustment of thermal range is required but thermal load is reasonably constant in each given range.

(3) Thermostatic expansion valve—used where temperature range and thermal load vary.

It will be seen, therefore, that the constant pressure valve is not suited for refrigeration machines where there is a fluctuating heat load condition. However, on water coolers, some domestic refrigerators and home freezers, room air-conditioners, ice cream cabinets, frozen-food cabinets and similar relatively constant load applications, the constant pressure expansion valve is admirably suited. In particular, because this type of valve fixes the lower limit of evaporator temperature by controlling the evaporator pressure, the valve is ideal for water-cooling equipment because it assures that freezing of the water will not occur and result in extensive damage to the equipment, if the valve is correctly set. This effect of temperature control on the evaporator can also be exploited to the control of humidity in air-conditioning equipment, where the level of humidity may be more important than the exit air temperature.

Constant Pressure Valve Troubles

Apart from mis-application by not appreciating the disadvantages of the constant pressure valve, the commonest complaints on valve performance

are brought about by dirty systems and moisture blocking the valve, also by having a plant with insufficient initial charge possibly worsened by repeated changing of the valve, which bring forward complaints of erratic performance. Another source of trouble is due to valve users leaving off the sealing cap of the adjustment, allowing the ingress of moisture, which, if the setting is low enough, freezes in the power element.

Another point which is not always appreciated with constant pressure valves is that if they are of the type which have metal sealing caps, the pressure sealed in the chamber above the power element is lowered by a drop in temperature and if a valve is set at normal ambient it can apparently drift 2 lb. per sq. in. during low-temperature operation. If the cap is slackened and then re-tightened, the atmosphere pressure can be re-instituted under the colder working conditions and the valve returns to its original ambient setting.

Constant Pressure Valve

"*TROUBLE CHART*"

Symptoms	*Remedy*
Gradual loss of refrigeration.	Valve blocked—check and clean filter. If associated with whistle in valve, plant short of charge—re-charge.
Periodic loss of refrigeration—restored after defrosting.	Moisture in system freezing in valve—fit drier.
Erratic control.	Plant short of refrigerant—re-charge. Moisture in adjustment head of valve alternately freezing and thawing—replace valve or as temporary arrangement introduce one or two drops of glycerine in head of valve. Leak into sealed adjustment head of refrigerant causing operating setting to rise; undoing sealing cap temporarily releases the trapped refrigerant—replace. Sealing cap may not be tight and valve adjustment head is breathing—tighten cap. Valve may be sticky in operation through dirt or defect—replace.
Valve setting falls on running plant.	Pressure in sealed adjustment head is falling due to fall in temperature of valve. Slacken sealing cap—allow to breathe and re-tighten.
Evaporator temperature not achieved although valve set to desired pressure.	Valve too small—replace with larger capacity valve.
Liquid entering compressor.	If evaporator still operating efficiently, check setting of thermostat and valve and ascertain they are reasonably comparable in terms of temperature and pressure for the plant refrigerant.
No refrigerant flowing even after thawing out valve.	Strainer of valve blocked—remove and clean or replace.
Frosting of inlet side of valve but loss of refrigeration on coil.	Blocked strainer—clean or replace.

THE PERSIAN GULF MARKET

THE building of new houses, both for private individuals, for the Government in Kuwait town itself, and for the Kuwait Oil Company at Ahmadi, 25 miles from the town, is continuing at a steady rate, states the export services branch of the Board of Trade in a report on domestic electrical equipment in the Persian Gulf. This creates a brisk demand for all types of domestic electrical fittings of the type in everyday use in the United Kingdom and in addition for ceiling fans and control switches, which are found in all but the very poorest homes, in shops and in offices. Fans are a necessity for seven months of the year. Kuwait uses for the most part the electric bulb for lighting, although fluorescent strip lighting is slowly becoming more popular, especially for shops and offices.

The demand for such domestic appliances as air-conditioners, washing machines, refrigerators, etc., comes largely from the better-off class of Kuwaiti (perhaps 20,000), immigrant Arabs with appreciable purchasing power (perhaps 10,000), Indians and Pakistanis of similar standing (perhaps 2,000) and the European community (2,250).

More and more of such people manage to buy at least one window-type air-conditioner. Most new houses are designed for air-conditioning. The price of electricity has been kept high to restrict consumption. When the new power station is working a reduction is expected which will increase demands for electrical appliances.

There is an increasing seasonal demand for refrigerators.

The Government of Kuwait is an important buyer of window-sill air-conditioners, iced-water dispensers, refrigerators, fans, etc. for its offices, hospitals, schools, etc. With the exception of the health department, which buys direct, the State buys by tender through local agents. The Kuwait Oil Company employs about 10,000 staff at Ahmadi, for whom it provides accommodation ; it purchases through the local market when its requirements are available here.

The standard of building in Kuwait is not high and most contractors, anxious to reduce their costs to the minimum, install cheap fittings. The price factor is, however, not entirely paramount in the electrical goods market.

International News

Singapore

Shroffs (Malaya) Ltd., of 18E, Battery Road, Singapore, 1 have informed the United Kingdom trade commissioner in Singapore that they are keenly interested in obtaining agencies with actual manufacturers of electrical goods such as fans, small refrigerators, small motors, starters, cables and any other small appliances or accessories in this field. The voltage and frequency in Singapore is 230/50. Shroffs (Malaya) Ltd., who were registered in 1950, are importers, exporters and general merchants handling a wide range of household goods. As well as their head office and retail store in Singapore, they have branches in Kuala Lumpur, Penang and Bukit Mertajam in the Federation of Malaya and at Kuching in Sarawak. The Singapore company is considered to be a suitable connection for United Kingdom firms. Manufacturers interested in this agency enquiry should write direct to Shroffs (Malaya) Ltd. It would be appreciated if, at the same time, they would notify the United Kingdom trade commissioner in Singapore, P.O. Box 620, Singapore, that they have done so.

Australia

The United Kingdom trade commissioner at Brisbane, has informed the Board of Trade that an Australian subsidiary of a United Kingdom engineering firm, with its own factories and servicing depots, is strengthening its sales organisation, particularly in Queensland, to meet a probable growing demand for engineering equipment and stores. The firm concerned wishes to represent, on an agency basis, United Kingdom manufacturers of non-competitive products. Only United Kingdom firms will be represented. The subject firm are well known in the Australian electrical, mining, railway, marine and sugar industries and are considered to be a suitable connection for United Kingdom firms. Manufacturers wishing to take advantage of this expanding sales organisation should write, giving full details of their products, to "Australian Agency," Export Services Branch, Board of Trade, Room 745 Lacon House, Theobalds Road, London, W.C.1.

Italy

The firm of O.S.V.A. (Officine di Sesto S. Giovanni e Valsecchi A.) of Via Monte di Pieta, 1, Milan, have informed the British consulate-general at Milan that they wish to get into touch with United Kingdom manufacturers of domestic electric appliances with a view to importing these products into Italy. They are principally interested in toasters ; coffee grinders ; mixers ; flour polishers and vacuum cleaners ; dish washers ; suction fans ; hair dryers ; air-conditioners ; convectors for heating and ventilation. O.S.V.A. are a joint stock company established in August 1906. They are manufacturers of cast iron enamelled baths, wash basins and other sanitary ware, kitchen ranges, stoves, geysers, electric refrigerators, taps, cocks, brass, bronze and iron castings. They have a large factory and foundry at Sesto San Giovanni, near Milan, employing some 700 workers. They have a sales organisation covering the whole of Italy with agents in all the principal centres. O.S.V.A. are considered by the Board of Trade to be a suitable connection for United Kingdom firms.

Pakistan

All calls for tenders on behalf of the Government of Pakistan, with the exception of those for certain specialized stores and equipment required by the railways, the post and telegraph authorities and the armed services, are made by the department of supply and development, states the Board of Trade. In calling for tenders, the department of supply and development adopts one of two procedures, depending on whether the invitations to tender are "limited" or "advertised." If in the first category, copies of the tender documents are sent to all firms who are registered as approved contractors to the department. The United Kingdom trade commission in Pakistan receives a copy of the tender documents in cases where the contract is worth Rs. 15,000 or above. This is forwarded to the export services branch of the Board of Trade for the information of United Kingdom suppliers of the goods in question. The great majority of calls for tenders are issued by the office of the director-general of supply and development at Karachi but "limited" calls for tenders may also be issued by the offices of the deputy directors-general, supply and development, at Lahore and Chittagong. "Advertised" calls for tenders are advertised in the daily press and a charge is made for the purchase of the documents. Any firm, whether registered as a contractor or an agent of an oversea manufacturer or not, who wishes to submit a bid, must purchase the documents since quotations are required to be made on the official forms provided.

Peru

The demand for domestic electrical appliances in Peru is growing. In 1956, imports of these goods from all sources had an approximate value of £2,735,000 as against £1,741,000 for 1955 and £1,131,250 in 1954. Major increases were in respect of refrigerators, washing machines, floor polishers, vacuum cleaners, food mixers and cooking stoves. The United Kingdom's share of the trade amounts to a little over 12 per cent. of the total. The market is worth cultivating as, in addition to the absence of quotas or any import licensing system, there are no cumbersome exchange restrictions and the exchange rate, which is free, has been stable for nearly three years. The average exchange rate in 1956 was 52.60 = £1. At present the sterling rate is about soles 52.95. Some 35 per cent. of the total value of Peruvian imports of domestic electric appliances is in respect of refrigerators and about 93 per cent. of these imports are of United States origin. Climatic conditions make the use of a refrigerator very desirable, and a big market exists for them. Some years ago, in 1950–51, United Kingdom manufacturers made a determined effort to break into the market. Unfortunately some of the refrigerators supplied were of poor quality and defective workmanship while in other cases the manufacturer had overlooked the fact that the current supplied in Lima is of 60 cycles. These faults were by no means true of all British refrigerators, but in this comparatively small market, where gossip travels fast, they were held against United Kingdom manufacturers as a whole, states the Board of Trade. Unfortunately, too the mistakes are still remembered. Accordingly potential importers now require every

form of inducement and guarantee before they are willing to invest capital and face the competition of well known and accredited United States manufacturers. According to Peruvian statistics, the value of imports of refrigerators from the United Kingdom fell from £161,000 in 1951 to £30,000 in 1952 and to £10,600 in 1955 ; in 1956 these imports recovered slightly, their value in that year being £15,600 but it is probable that most of these imports were in respect of commercial types of refrigerators.

Poland

Mr. J. Czaplewski, of Gdynia Ship Repair Yards, has told the British Embassy at Warsaw that there were many items which the shipyards require and which might be supplied from the United Kingdom—for instance, 240 h.p. diesel engines, lighting and refrigerating equipment, for the 200-ton fishing vessels which are built in Gdynia. Interested firms should write direct to : W. Pan J. Czaplewski, Gdynska Stocznia Remontowa, Waszyngtona 1, Gdynia, Poland. It would be appreciated by the Board of Trade if at the same time, responding firms would notify the British Embassy, Commercial Secretariat, Aleja Roz No.1, Warsaw, that they have done so.

Trinidad

A Board of Trade special register circular dated November 30, 1956, gave information about the new " Hilton " hotel for Port of Spain. Subsequently, a report dated December 18, 1956, announced that the Trinidad Government had decided to defer the project for the time being. The United Kingdom trade commissioner, Port of Spain, has now reported that according to a leading article published in the *Trinidad Chronicle* it was announced that :—" in the Chief Minister's Budget speech and in the development programme that the Government will provide the first $5,000,000 of the expenditure for constructing this $9,500,000 hotel, and will borrow the remainder from a local bank as an when required. The hotel will be leased to Hilton Hotels International under a 20-year agreement. In addition, the article stated that " In fact the Government plans to have construction started this year, though in view of the work remaining to be done by the architects and the inevitable waiting period when tenders are called for and considered a start is unlikely before November, 1958."

Cuba

Sr. Raul Gutierrez, Jr., a director of the Anderson Trading Company, Havana, has advised the British Embassy in Havana that the Cuban Government has approved in principle the construction and equipment of 14 hospitals. Not all these hospitals will be new buildings and the equipment of those which are to be installed in already existing buildings will, in the final stage, be a matter of considerable urgency. The contract for the equipment of all 14 has been awarded to an associate company of the Anderson Trading Company whose social style is, Suministros Tecnicos y de Hospitales, S.A., of Edificio N, Octavo piso, Calle N entre 21 y 23, Vedado. The equipment required will be everything that goes into a hospital and will be valued at about $17,000,000. Manufacturers interested in supplying their products should send c.i.f. Havana quotations in U.S. dollars.

HAY'S WHARF

At the fiftieth annual general meeting of the Proprietors of Hay's Wharf, Ltd. held recently in London, Sir Rupert de la Bere, Bt., K.C.V.O., chairman and joint managing director, said, in part :—" I am glad to report that for the year ended September 30, 1957, the group as a whole experienced favourable trading conditions which resulted in a profit of £292,346 after deduction of taxation, compared with £196,669 in 1956.

" A substantial proportion of the group capital expenditure has been and must continue to be earmarked for the maintenance of the competitive power of the various companies comprised in the group, and the whole of the sums invested cannot therefore be regarded in terms of increased earning capacity. For instance, depreciation charges are insufficient to meet the increasing costs of replacing such expensive items of equipment as cranes or tugs ; or to replace old warehouses with modern buildings providing specialized storage facilities.

" Working capital employed in the group during the year has increased with the increase in the turnover.

" The prosperity of the group is bound up with the trade of the country in general and of the Port of London in particular, and therefore it is somewhat difficult to make a forecast of the volume of business and profits in the years ahead. I can only say that the board's policy of improvement and diversification of facilities and services offered to importers and exporters will enable our companies to maintain and develop their businesses. Provided that no further heavy increases in costs arise and assuming there will be no serious recession in the country's overseas trade, it is my opinion that the company should be able to maintain its present distribution by way of dividend."

The Proprietors of Hay's Wharf Ltd. organization includes the following units :—Hay's Wharf Ltd. (and subsidiary companies), John Trapp & Son (Hay's Wharf) Ltd., Pickfords and Hay's Wharf Shipping and Forwarding Co., Ltd., Pickfords (South Africa) Ltd. (and subsidiary companies), Waterloo Bonded Warehouses Ltd. (and subsidiary companies), Humphery and Grey (Lighterage) Ltd (and subsidiary companies), Marshall's East African Holdings Ltd., Continental Express Ltd , with head office in London and subsidiary companies in Belgium, Germany, France, Austria, Switzerland and Holland.

NEW HYGROMETER

A new hygrometer with an immediate response, stable characteristics and provision for easy checking and standardizing, as well as remote reading, has been marketed by Shaw's of Bradford. The hygrometer is essentially simple, robust and reliable. The small detecting element consists of a capacitor with a hygroscopic dielectric, only a few microns thick, with a 24-carat gold electrode. The detector is contained in a small, strong, fine wire gauze protector, which plugs into a coaxial cable connecting it to the recorder. The detecting element is 1 cm. in diameter and 6 cms. long, and can be used with any length of cable. Shaw electronic hygrometers have already been successfully used as standard instruments by which checks are easily made on industrial relative humidity controllers, such as are fitted in many factories. Another important use is for quick estimation of moisture in hygroscopic materials. The moisture content of urea moulding powders, for example, can be ascertained to better than one part in a thousand. The detector is simply placed in the material to be tested, and after a few seconds, when the pointer is steady, the moving coil meter indicates the moisture of the material on the easily read scale.

* * *

Kiangsons Trading Company, Ltd., 1265 Chungcheng Road, Taipei, Taiwan, have informed the British consulate at Tamsui that they are interested in obtaining United Kingdom agencies for—a range of equipment including air-conditioning plant. In a letter to the British consulate the Taiwan firm say :—" Our chief aim is to try to sell British manufactured commodities to Taiwan market through invitation-to-bid usually handled by Central Trust of China."

The Institute of Refrigeration Bulletin

Institute Headquarters: New Bridge Street House, New Bridge St., London, E.C.4 (CENtral 4694)

APRIL MEETING

At a meeting of the Institute to be held at 5.30 p.m. on Tuesday, April 1, at the Junior Institution of Engineers, Pepys House, 14 Rochester Row, Westminster, London, S.W.1, Dr. G. G. Haselden, B.SC., associate member, and Dr. L. Klimek, DIPL.ING., will present a paper entitled " An experimental study of the use of mixed refrigerants for obtaining cooling over a temperature range."

The following is an abstract of the paper :—

Mixed refrigerants are considered for duties involving the continuous cooling of a fluid through a temperature range, for instance the chilling of a stream of water. If the temperature is chosen so that the range of temperature over which it evaporates matches the range of temperature of the cooling load then a close approach to thermodynamic reversibility is possible, leading to low power consumption.

The mixed refrigerant cycle is analysed theoretically and the importance of maintaining near equilibrium conditions during condensation and evaporation is demonstrated. An account is given of a small pilot scale apparatus circulating a mixture of propane and butane, and the results obtained are reported. A small power saving was achieved, the amount of saving being limited by the heat transfer conditions.

The implications of this work are considered in relation to certain large scale refrigeration applications.

Preservation of Cells at Low Temperatures

INTRODUCING her paper on " Preservation of cells and tissues at low temperatures " before The Institute of Refrigeration last month with an historical survey, Dr. Audrey U. Smith, M.B., B.S., of the division of experimental biology, National Institute for Medical Research, Mill Hill, said : " The pioneer in low-temperature biology was Robert Boyle. Two hundred and eighty years ago he found that fruit, vegetables, eggs and meat could be preserved for remarkably long periods in the cold and that they were unspoiled when re-warmed provided that they had not been frozen. After freezing and thawing, however, the texture of the various bodies became altered. Boyle also discovered that living frogs and fish recovered after the water surrounding them had been frozen for a day or two even when the bodies of these animals were stiff with cold and although they appeared inanimate when the ice was broken. They did not survive if they had been encased in ice for more than three days. The account of these experiments in his book ' New Experiments and Observations Touching Cold ' (Boyle, 1863) is still worth reading to-day. Boyle, who was primarily a physical chemist, was greatly hampered in his research by the lack of means for producing and measuring cold. Since his time progress in low-temperature biology has depended upon advances in chemistry, physics and engineering.

" The invention of accurate thermometers by Fahrenheit and Reaumur in the early 18th century led to a spate of observations on the degrees of cold which living plants and animals would withstand under natural conditions. Spallanzani (1787) was one of the first to use mixtures of ice and various salts to produce low temperatures and to study the effects of intense cold on insects and other animals in the laboratory.

" During the 19th century experiments on the biological effects of moderate degrees of cold were facilitated by refrigerating machinery designed by Kirk, Coleman, Perkins, Ewing and other engineers. The basic chemical processes on which the life of plants and animals depend were worked out and were found to depend on temperature. They were accelerated by warming to about 45° C. and slowed by cooling. The temperature of the cold-blooded animals, such as reptiles and fish fluctuated with that of the environment and their activity rose and fell correspondingly. This was the great age of exploration and travellers in the far north brought back vivid tales of insects, fish and frogs reviving when thawed after many weeks in the frozen state. By contrast, it was found that most mammals maintained a steady internal temperature of about 38° C. even when exposed to cold and died if the body temperature fell below about 20° C. However, some mammals, such as hedgehogs, dormice and ground squirrels, could hibernate and remained torpid with low body temperatures throughout the winter. The idea persisted, strongly supported by fiction, that it should be possible, by suitable refrigeration, to keep mammals of all species in a state of hibernation, and that, if the temperature were low enough, old age could be staved off in this way.

" Then, between 1877 and 1898, oxygen, air, and finally hydrogen were successively liquefied by Pictet, Linde and Dewar. Biologists hastened to test the effects of these new reagents. Before the end of the century it was established that bacteria and seeds of plants survived storage at temperatures between −180° and −253° C. After re-warming to normal temperatures the bacteria multiplied in cultures while the seeds germinated and plants grew from them in the usual way. The chemical changes involved in the life of the cells would have been impossible at the temperatures of the liquid atmospheric gases. Clearly, the bacteria and seeds had been in a state of suspended animation and presumably they would have remained in that state indefinitely at that range of temperature (Brown & Escombe, 1897).

" It seemed possible that animals could be preserved in a state of potential immortality in the same way. Gradually, however, it became apparent that the majority of animals and their component cells and tissues were exceedingly

sensitive to being frozen and thawed, presumably because of the destructive effects of the ice crystals. They would not survive being stored in the frozen state at any temperature between the freezing point of water and the absolute zero."

Turning to more recent work, Dr. Smith declared that : " By 1940 it seemed firmly established that survival at low temperatures was limited to organisms in which crystallization of ice could be avoided either by preliminary desiccation or by supercooling or vitrifying the tissue fluids (see Luyet and Gehenio, 1940).

" Some minute animals such as rotifers and tardigrades, which live in ponds, survive drying under natural conditions. Bequerel (1936) found that when these organisms had been desiccated completely they would survive storage in liquid helium at –269° C. When re-warmed and moistened they resumed full activity. Very few living animals or their component tissues survive desiccation and Becquerel's technique certainly could not be applied to the preservation of mammalian cells and tissues. Other small animals, notably frost-hardy insects, survive severe cold in the supercooled state. The lowest temperature to which they can be supercooled is approximately –40° C. At temperatures between 0° and –40° C. chemical changes are not completely arrested so that the period for which the animals can remain supercooled is limited. Furthermore, the supercooled state is inherently unstable so that water may at any time crystallize as ice. For these reasons there seemed no prospect of storing living animals and their cells and tissues for prolonged periods in the supercooled state. Vitrification can only occur when minute amounts of fluid are cooled to very low temperatures at any ultrarapid rate so that there is no time for ice to crystallize. The material must also be re-warmed very rapidly to prevent crystals forming during melting.

" In 1948, Dr. Christopher Polge joined the Medical Research Council's staff to work on poultry breeding and, in particular, on the biology of fowl spermatozoa. One problem was to preserve semen for use during the summer months when cocks moult and refrain from mating. Quite by accident we found that glycerol prevented the otherwise damaging effects of freezing and thawing cock spermatozoa. In presence of glycerol the semen could be kept at –190° C. and when re-warmed days or weeks later the spermatozoa resumed full activity (Polge, Smith & Parkes, 1949). Provided that the glycerol was removed by gradual dialysis before insemination the semen retained normal fertilizing capacity and many normal chicks were hatched from semen which had been stored in this way (Polge, 1951). Attempts to repeat the experiments with mammalian spermatozoa were at first unsuccessful. The spermatozoa of rabbits and guinea-pigs and other laboratory mammals did not tolerate high concentrations of glycerol. Bull spermatozoa, which were highly active in presence of 10 to 15 per cent. of glycerol, did not survive being cooled rapidly to –79° C. in test-tubes by the method used for fowl spermatozoa nor did they survive vitrification by Luyet's technique. At this point it struck me that bull spermatozoa which do not tolerate rapid cooling between body temperature (+38° C.) and 0° C. were unlikely to survive being cooled rapidly at temperatures below 0° C. Accordingly glycerol-treated bull semen was cooled slowly to –79° C. with the result that large numbers of spermatozoa resumed active swimming when thawed. The best procedure was to cool the semen slowly at the rate of 1° C. per minute down to –15° C. when freezing took place. The rate of cooling was then increased to about 5° C. per minute between –15° and 17° C. The semen was subsequently thawed hours, days or months later by immersing the ampoules or test-tubes in a water-bath at +40° C. When this technique was followed a high proportion of spermatozoa revived after thawing (Smith & Polge, 1950 a and b).

" This was a turning point in our work. The development of methods for storing mammalian red blood cells and a variety of tissues have depended both on the use of glycerol and on cooling the material slowly to very low temperatures. The fact that cells survived slow cooling also enabled us to study the mechanism whereby glycerol protected them. In the first place we enlisted the help of Mr. Smiles and devised a simple apparatus for cooling preparations to very low temperatures under the microscope.

" The optimum rate of cooling was sufficiently slow to enable us to store at very low temperatures samples of bull semen sufficiently large for subsequent insemination into cows. The Agricultural Research Council provided facilities for these experiments at the Cambridge and District Cattle Breeding Centre where Dr. Polge collaborated with Mr. Rowson. Preliminary trials showed that glycerol did not reduce the fertilizing capacity of unfrozen semen and that there was no need to remove the glycerol before insemination. The glycerol-treated semen could be kept overnight at +5° C. without deterioration, and when it was then cooled to and kept at –79° C. the activity of the spermatozoa after thawing was greater than in samples frozen soon after collection and dilution. Cows became pregnant after insemination with samples treated in this way. There was no decrease in fertility of semen which had been stored at –79° C. for periods up to a year and all the calves born as a result of its use were normal (Polge and Rowson, 1952 and b ; Rowson and Polge, 1953). The reports of these results in 1952 created a sensation among cattle breeders. During the past five years the method has been tested and taken into routine use at all the major artificial insemination centres in Great Britain, Europe, North and South America, Australia, New Zealand and other parts of the world. Several million calves have been born to cows inseminated with glycerol-treated frozen spermatozoa. In some centres Polge's original technique is followed in every detail. Elsewhere the procedure has been modified slightly. So far, however, no fundamentally new principle has emerged and bull semen which is to be stored for prolonged periods at very low temperatures is still diluted to contain between 6 and 10 per cent. of glycerol in a medium containing sodium citrate and either egg yolk or milk. After a period for equilibration, ampoules of the diluted semen are then cooled slowly to and kept at a temperature below –70° C. In the U.S.A. and Canada automatic electric machines are now used in many centres to cool the semen at the desired rate and to store it at a steady temperature between –79° and –100° C. Refrigerating apparatus of this kind would be a great convenience in this country and would facilitate all branches of low-temperature biology, besides reducing the enormous expense now incurred by using solid CO_2.

" Refrigeration engineers may wonder why it should be necessary or desirable to inseminate cattle artificially at any time and what are the special advantages of storing semen for prolonged periods in the frozen state. At natural mating a vast surplus of spermatozoa pass into the reproductive tract of the female. When bull semen is collected artificially it can be diluted 100- or 200-fold and a single specimen used for inseminating 500 to 1,000 cows. Pregnancy would not, however, ensue unless the cows were at the particular stage of the reproductive cycle when an egg is shed from one or other ovary. It was therefore necessary to find some way of storing the semen in order to make full use of the potentialities of individual bulls and, in particular, of the best specimens of the various breeds. Until recently, semen could only be kept for three days at +5° C. After that period the quality deteriorated. As a result, there was a considerable wastage of semen and also a limit to the distance to which it could be transported. Now that semen can be stored for indefinite periods at very low temperatures these limitations of time and space have been abolished (Parkes, 1956).

BOOKS RECEIVED

The Story of Expanded Rubber. By A. COOPER, F.R.I.C., F.I.R.I., F.P.I., M.INST.R. Published by Expanded Rubber Co., Ltd., Croydon.

This nicely produced volume, published to mark the 21st birthday of the company last year, has a foreword by Dr. Ezer Griffiths, O.B.E., F.R.S. who, before he retired, was head of the heat section of physics department at N.P.L., where most modern insulants are sent for test. Dr. Griffiths first came across the material in 1921 and he realized it had possibilities as a thermal insulator ; his expectations were soon confirmed. The author is technical director of the company but he has resisted the temptation to delve too deeply into the technology of the subject and has produced a book that is most fascinating to read. There can be few in the industry who do not know the name of " Onazote " but the history of the development of this product will now find many ardent readers.

" The Engineer " Buyers Guide, 1958. Published by " THE ENGINEER," 28, Essex Street, London, W.C.2. Price 7s. 6d. (Plus 1s. 9d. postage.)

Entries in this book are confined to firms advertising in the weekly journal or in the guide itself ; even so, they number 1,766 and represent all branches of the industry. The buyers' guide section comprises 688 pages with 32,000 entries arranged under 2,300 headings, with 1,300 cross references—altogether an imposing and useful tome.

1958 Year Book of the National Federation of Cold Storage and Ice Trades. Published by that body at New Bridge Street House, London, E.C.4. Price 10s. 6d.

This now familiar desk diary contains some interesting articles while the reference section, including the full list of Federation stores up and down the country, is always worth having close at hand.

" Isceon." A research department publication of Imperial Smelting Corporation Ltd., 37, Dover Street, London, W.1.

This book outlines the development of a new process by the research and development staff of Imperial Smelting Corporation which led to the erection of a full scale commercial unit at their Avonmouth works. The applications of " Isceon " as refrigerants and aerosol propellants are described in considerable detail. The book also contains the latest information available on the physical, chemical and thermodynamic properties of " Isceon-122 " and " Isceon-131." Brief notes on other " Isceon " products under development are included. For the first time, a series of nomographs is published, giving the variation with temperature of useful physical properties of " Isceon-122 " and " Isceon-131 " mixtures. A cursor which fits neatly into the back of the book is provided for convenience in reading the nomographs. This publication is available free of charge to interested persons upon application written on their company's letter heading.

Meat Trade Annuals and Directories of Animal By-Products (Midland and North-West editions). Published by WHEATLAND JOURNALS LTD., 1, Stamford Street, London, S.E.1. Price 21s. each. Copies from 157, Hagden Lane, Watford, Herts.

These further volumes in the series which started with that devoted to London detail trade associations and organisations and have a retail butchers' section which should be of special interest to the refrigeration industry.

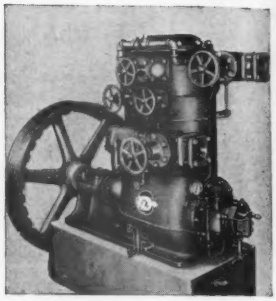
Motivation Research. By HARRY HENRY. Published by Crosby, Lockwood & Son Ltd., 26, Old Brompton Road, London, S.W.7. Price 30s.

The author of this book has had 20 years of experience in the research field and is a director of an international advertising organization, McCann-Erickson. He describes motivation research as—" The use of research techniques designed to penetrate below the surface, and particularly of techniques borrowed and adapted from psychology, in conjunction with the standard techniques of consumer research of the " behaviourist " type." This is a technique that can deal with such subjects as " Why do housewives prefer certain goods to others ? " " How can manufacturers find out whether a new product will be successful ? " In recent years there has been great controversy over what is known as motivation research, in which certain psychological techniques are employed to discover what people really think. This kind of research has been attacked as immoral and unreliable. The leading British authority on this subject has now published this book with the belief that, correctly employed, this form of research can be of value to both manufacturers and industry in many different ways.

The firm of Dr. Eduard Groeger, Muenster (Westf.), Zumbrockstrasse 11, have informed the British consulate-general at Dusseldorf that they wish to get into touch with United Kingdom suppliers of deep-freeze cabinets for agricultural use (in farmhouses, etc.) in sizes about 220 litres, 350 litres and 560 litres. The German company, who were established shortly after the last war, are agents dealing in agricultural machinery.

COMMERCIAL AND INDUSTRIAL SECTION

Manufacturers' and distributors' news



What is claimed to be the biggest and most modern showroom in the Midlands devoted exclusively to refrigerated products was opened last month by **Refrigeration (Birmingham) Ltd.**, at Smithfield House, Digbeth. The new showroom occupies 2,200 sq.ft. of floor space and is decorated throughout in an imaginatively contemporary fashion. Forty refrigerated items including a full-size cold room with the latest Prestcold automatic defrosting unit, domestic refrigerators, trade display and self-service cases, and Prestcold refrigerating units, are on show. The accent is on colour. Not only in the showroom itself which has a two-level floor, and striped wallpaper—but in the products themselves, which range from pastel blue and green domestic refrigerators, to the rich red and yellow Formica finishes used in display and self-service counters for the trade. A feature of the showroom is the use of fluorescent lighting and the adjustable spotlights recessed into the pale blue ceiling. Many butchers, grocers and other people in the trade were invited to the opening and were eligible for entry into a competition which involved guessing the weight of frozen foods held in one of the refrigerated display cabinets. First prize was a Prestcold 8 c.ft. *de luxe* refrigerator worth £170. The new showroom fulfils a long-felt want in the Midlands. Devoted exclusively to refrigerated products, members of the general public and the trade can inspect all the items at their leisure in spacious, warm and pleasant surroundings.

* * *

The plastic material used for the base of the gay Electrolux traytop (mentioned in our last issue) was supplied through the new Hardec Design Service. The **Airscrew Co. & Jicwood Ltd.**, manufacturers of Hardec, have introduced this service to give industry, architects and designers generally the opportunity of having their own exclusive patterns and colours produced in a wear-resistant melamine surfacing. In addition, the Airscrew Company will now accept commissions from industrial and commercial users for the production of special designs, or alternatively, will offer the choice of selection from a wide range of existing ones.

* * *

With a final payment of 6¼ per cent. against 2½ per cent. **Marco Refrigerators Ltd.** are increasing

their ordinary dividend for the year ended September 30 to 8¾ per cent. from 5 per cent. for 1955–6. Due to increased efficiency and productivity group net profits rose to £41,547 from £14,129, before tax of £22,554 (£7,683).

* * *

As from the next production run of **Lec's** 2 c.ft. model, the Coronet, which is due to take place in mid-March, the firm proposes to include an extra shelf. Shelf area will in future be 3.6 sq. ft. instead of 2.7 sq. ft. as hitherto. The evaporator has been redesigned and now has a far more attractive appearance coupled with greater ease in cleaning. In future, too, no charge will be made for cartons of delivery. Unfortunately a price increase has proved unavoidable and the new figures are :—List price £30 5s. ; purchase tax £13 14s. 3d. ; service fee £2, making a total of £45 19s. 3d. A well-known firm of contractors has asked Lec to design plastic louvres to be built into the kitchens in their smaller houses so that the Coronet can be immediately installed should the new tenant so desire.

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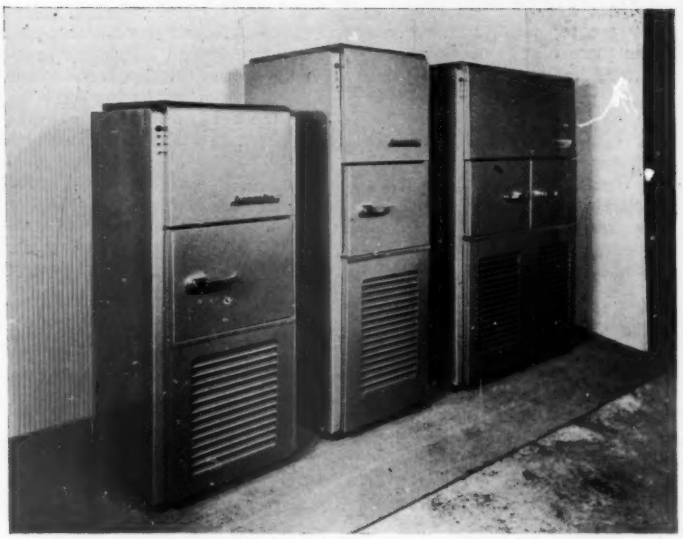


Recently exhibited in London was the latest range of **Icemaster** automatic ice makers. These machines produce ice by an entirely automatic process—in both a conventional cube form and also in a new shell form. There are three models—the Mini, the Standard and the Major ; the capacities of these are 4,500, 8,000 and 16,000 ice cubes daily.

* * *

Shell Chemical Co. Ltd. have introduced the trade name of " Carlona " for their range of high density polyethylenes. These poly-

This photograph illustrates the attractive " wedding gift parade " display material produced by Morphy-Richards to link up with their intensive press and television advertising campaign during March.

ethylenes are of Ziegler type and their greater rigidity and strength make them of particular interest in the moulding and extrusion fields.

* * *

A new catalogue on commercial refrigeration has been issued by The **Insulated Storage & Display Company** of Gloucester and deals with sectional cold stores, display counters, display cabinets, counter tops and service cabinets.

* * *

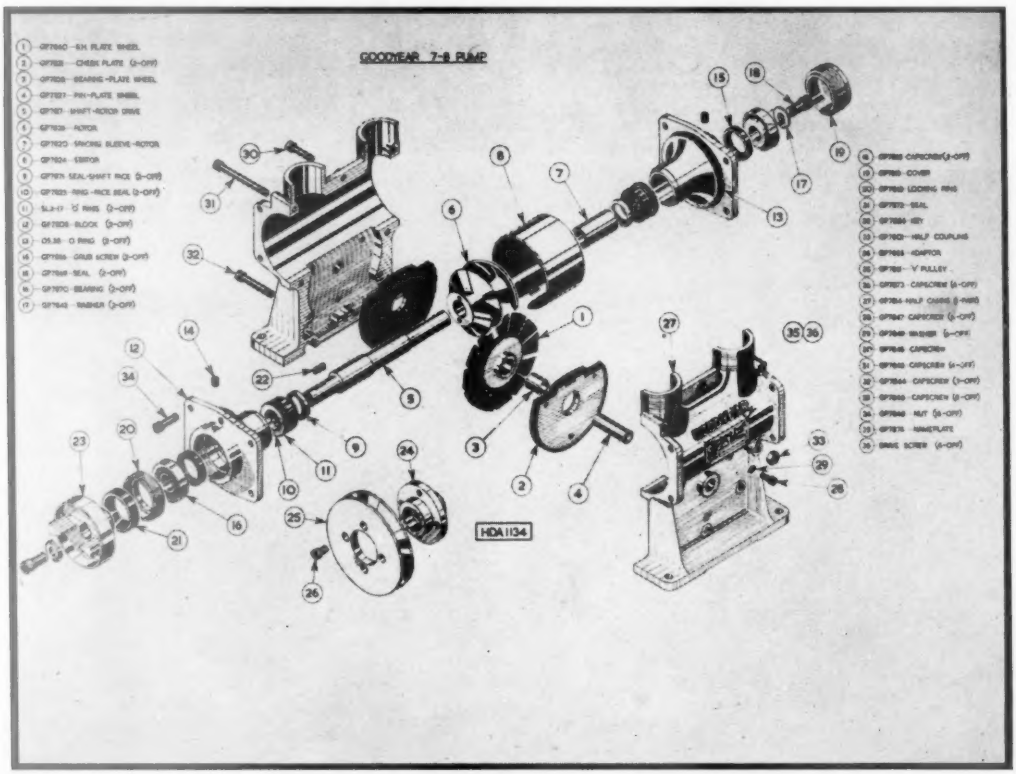
The American associates of **Head Wrightson Processes, Ltd.**, the Fluor Products Company, have designed a new plastics packing for " Counter-flo " cooling towers which is known as " Poly-Grid." This packing is stated to produce a greater cooling surface and a better heat transfer than is possible with the standard timber grid decks at present in common use. The new grid has an open construction and its pressure drop is low, permitting more water to be cooled, or a greater degree of cooling under existing operating conditions. Further research has also resulted in the development of asbestos panels for the construction of cooling tower walls, as an alternative to timber panels, and of off-set louvres which decrease the pressure drop of the air drawn into the tower.

* * *

The plastics division of the **Telegraph Construction & Maintenance Co. Ltd.**, has developed a new range of laminates combining paper, polythene and hessian. By means of the extrusion coating technique, a hessian mesh is firmly sealed to paper with a layer of polythene which covers the mesh completely. The result is a material which is strong mechanically and proof against moisture. It will also withstand temperatures up to 140° F without deterioration and can, for short periods, be subjected to temperatures near 200° F. By varying the mesh, the type of paper, and the thickness of the polythene layer, a number of different laminates of this character can be made to suit individual requirements. A sandwich construction with paper on both sides of the hessian mesh seems to offer the greatest possibilities. Where the best possible retention of mechanical properties in damp conditions is required, paper of high wet-strength is used.

* * *

" Break-down " drawing of the main components of the revolutionary new Goodyear 7-8 pump mentioned in these columns last month.



The imposing frontage of the new factory of Durable Plastics Ltd. at Guildford, Surrey. Much work for the refrigeration industry is undertaken here—mainly the coating of refrigerator shelves with PTFE material; a new field is likely to develop in the coating of freezer plates to prevent the sticking thereto of quick-frozen food packages. The treatment for 'fridge shelves is ideal since it renders them rustproof and stops discoloration while the surface is non-toxic and hard-wearing.

New models with increased capacity are being developed by **Jackstone Foster Ltd.** The new standard 15-station model " A," operated on dichlorodifluoromethane, has a load capacity of 1,680 lb. compared with the Senior at 784 lb. Dimensions of the cabinet are 7 ft. 6 in. by 4 ft. 6 in. by 7 ft. 6 in. high plus 4 ft. for hydraulic jack making it 11 ft. 6 in. high. The dimensions of the refrigeration unit are 6 ft. 8 in. by 4 ft. by 5 ft. 6 in. high. The maximum opening of plates is 3½ in., while the electricity consumption is 20 units per hour and water consumption—1,000 gallons per hour. Loading is achieved at the front and rear. The general design of the freezing cabinet is similar to the " Jackstone " Senior and Junior models, but contains 15-stations and has a separate refrigerating unit.

* * *

A new handy instrument called the Psychron gives extremely accurate relative humidity and dew point information with the flick of a switch. It is a battery-powered portable psychrometer designed and manufactured to meet rigid U. S. Weather Bureau specifications. Unlike ordinary sling psychrometers, the Bendix Psychron requires no whirling or special technique to operate. Three standard-size flashlight batteries power a tiny fan that draws air over wet and dry bulb thermometers at a rate exceeding 15 f.p.s. As a result, the Psychron can be safely used in closed quarters. It has built-in illumination for use in dark or poorly lighted areas Makers are **Bendix-Friez,** 1498 Taylor Avenue, Baltimore 4, Maryland, U.S.A.

* * *

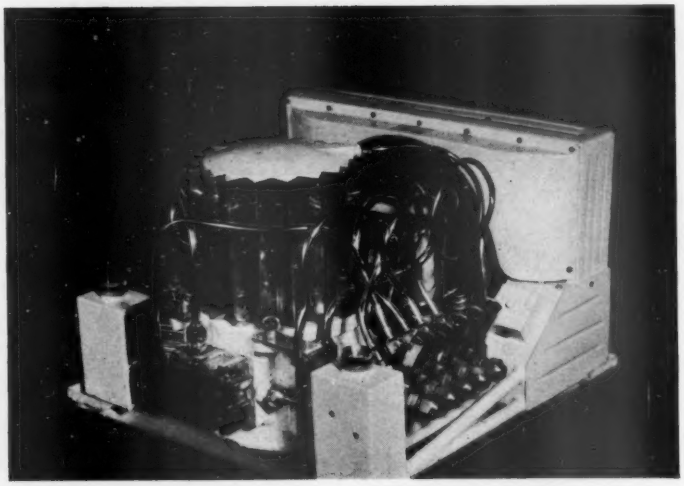
The main advantage of an automatic vending machine is that this 24-hour salesman will work for seven days a week. Furthermore this is a cash trade with small overheads, and the machine itself has advertising value, as it provides customers with a service unobtainable elsewhere. During the war years automatic vending largely ceased to operate in this country. This was due, in the main, to shortage of goods, but rising prices also made it difficult to adapt machines economically. In America, however, this setback was not experienced and automatic vending machine manufacturers continued research and selling. Today these machines are found in supermarkets, outside small retail shops, in big departmental stores and in a number of more unusual outlets such as petrol stations and dance halls, sports stadiums and places of entertainment. Milk offers the greatest food value for money in Britain. The **Vendo** automatic machine was responsible for selling 50,000,000 gallons of milk in the United States last year. This machine is now being built and sold under licence by Joseph Sankey & Sons Ltd., of Hadley Castle Works, Wellington, Shropshire, whose newly formed Vendo division has carried out a considerable programme of research with support and assistance particularly from the dairy industry, the National Dairyman's Association, the Milk Marketing Board and the Ministry of Agriculture. The Vendo, which has a capacity of 210 half-pints, makes it possible to offer three selections—milk, flavoured milk and an orange drink

The cabinet is about 6½ ft. in height and occupies 4.06 sq. ft. It is finished in two-tone stove-enamelled blue and has a colourful point-of-sale sign to attract custom. The vending mechanism is built of aluminium and stainless steel, easily kept bright and clean. The cabinet is modern and attractive the point-of-sale sign being illuminated by two fluorescent lighting tubes. It is, of course, refrigerated.

* * *

A special train named "**The Hoover Limited**" carried delegates between Victoria and Eastbourne to the conference of Hoover sales managers recently. Headed by the managing director, Mr. S. Roberts, and Mrs. Roberts, and the general sales manager (home), Mr. R. T. Griffiths, and Mrs. Griffiths, the sales managers and their wives, numbering in all some 300 people, attended from all parts of the British Isles as well as from Finland, France, Germany, Belgium, Holland, Italy, Norway, Sweden and Switzerland.

* * *



A condensing unit that has been causing a great deal of comment, particularly since it was shown at the Dairy Show last year is the Sylvian, described as a "serviceable sealed unit." Working on "Freon-22," it is made in a range of up to seven cylinders and is finding considerable application in atomic power work. Designer of the machine and managing director of the firm that makes it, Western Detail Manufacturers Ltd., is Mr. L. A. J. Gardiner, of Bristol, whose "baby" it has been for seven years now. In use, this unit is effectively "sealed." Nevertheless, it offers every facility for complete testing, maintenance, and repair on the spot by ordinary service engineers.

Mr. R. J. Kingsnorth, M.I.E.E., A.M.I.MECH.E., has recently been appointed manager of the process control division of Elliott Brothers (London) Ltd., a member of The Elliott-Automation Group. Mr. Kingsnorth has been connected with the electrical instrument industry for over 25 years, and for the past 17 years has been manager of the Erith instrument factory of Salford Electrical Instruments Ltd.

IMMERSION FREEZING

(*Continued from page* 234)

by freezing and is more readily thawed out in the event of a freezeup.

"In either case the heat exchanger should be designed for a maximum temperature difference of 5° or 6° F. This makes it possible to control the brine temperature quite well by means of a back pressure regulator and thus minimize the possibility of freezing the brine.

"Immersion freezing is a practical means of supplementing existing freezers in turkey processing plants. Freezing is not completed in the tank and it is necessary to put the birds into a freezer as soon as they are taken from the tank. However, the rate at which the final freeze takes place is not critical, so long as the surface is not allowed to thaw. Thus by choosing a suitable temperature and immersion time to match the existing freezer capacity, the engineer can considerably increase the daily freezing capacity and at the same time gain the advantages of the faster freeze."

A scene from the Frigidaire play presented during the afternoon session at the Scala Theatre.

Frigidaire's Sales Convention

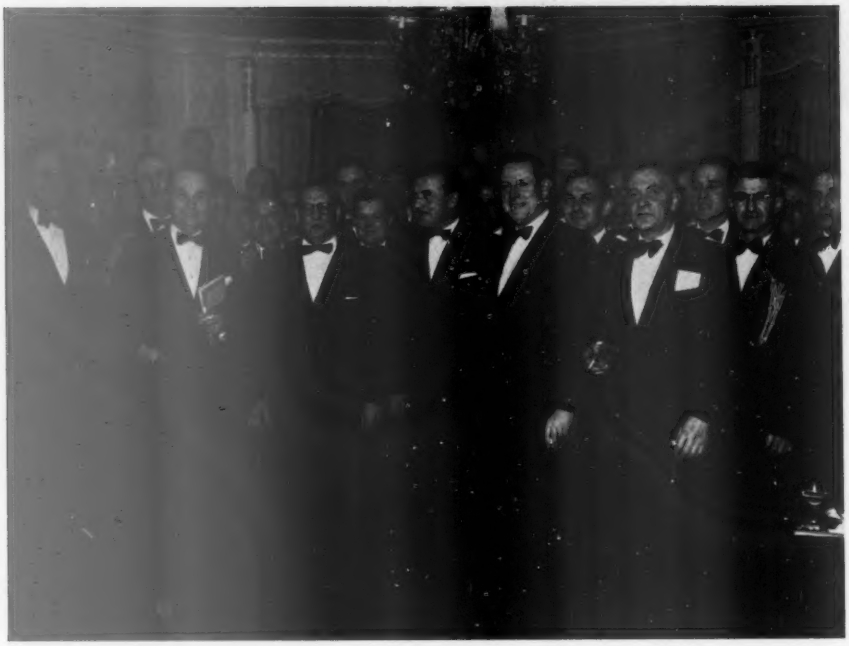
Piquant performances maintain freshness of this now traditional event

AS we briefly announced last month, sales of Frigidaire equipment reached an all-time record in 1957. This was announced by Mr. A. W. Porter, director and general manager, at the sales convention in the Scala Theatre, London. The year had begun in an atmosphere of gloom—Suez crisis, petrol rationing, credit squeeze—but in spite of everything the Frigidaire team had done a wonderful job, he said.

FRIGIDAIRE ANNUAL CONVENTION

The five-point development programme, introduced in June, had been the year's most significant event for the company and subsequent experience had vindicated decisions made at that time. Substantial gains had been recorded in every sales category—frozen food cabinets had been especially successful—and he was proud of the fact that Frigidaire had taken the biggest-ever part of total industry sales.

Mr. Porter was speaking at the conclusion of an afternoon's programme at the Scala Theatre. This, as on previous occasions, had been presented in the form of a theatrical entertainment, and from the TV. Toppers at the beginning of the programme to the line-up at the final curtain, was put over with the company's usual verve and precision. Jimmy Wheeler, who is now appearing in Pantomime at Golders Green, followed the TV. Toppers with characteristic comments on life in general (and beer in particular) but the bulk of the afternoon consisted of a play in 12 scenes showing the progress of a Frigidaire salesman from casual interest in his job to knowledgeable enthusiasm. Written by K. H. Vere, sales promotion and advertising manager, L. J. Bantick and Ronald Wild, it was presented by a cast of professional



Mr. A. W. Porter, director and general manager of Frigidaire Division of General Motors Limited, third from left, surrounded by members of the Frigidaire Club and some sales executives at the Dorchester Hotel.

actors and actresses, led by Nicholas Grimshaw, and was directed by Donald Masters.

Mr. G. E. Worssam, general sales manager, spoke at the end of the programme on the growth of the various categories over the past year and on the need for even greater efforts in 1958, and he was followed by Mr. K. H. Vere, who outlined the company's advertising and sales promotion plans

Mr. G. E. Worssam, general sales manager of Frigidaire Division of General Motors Limited, proposes the toast to "our guests" at the convention banquet held in the ballroom suite of the Dorchester Hotel.

The new-style Manhattan range of open-top display cases is a big seller. Here Mr. Eric Davies, commercial sales, demonstrates certain of its features.

for the next 12 months. A banquet and cabaret was held at the Dorchester Hotel later that evening, and on the next day there was a trip to the Frigidaire factory at Hendon.

Mr. E. Jordon, of F. W. Fidler & Son Ltd., Frigidaire's Manchester distributors and president of the Frigidaire Club, addressed the assembled home and overseas delegates at the banquet. Earlier in the day Mr. Jordon had been presented with the president's cup as leading salesman of the Frigidaire organization for 1957.

Low Temperature Recovery of Olefins

By L. B. BAKER, B.Sc., M.Sc.

(Continued from January)

Fractionation

The demethanizer presents a combination of design problems infrequently encountered elsewhere. For the production of an ethylene stream with a purity of 99.9 per cent. the methane leaving in the demethanizer bottoms must be reduced to very low levels while at the same time the ethylene loss in the overheads from the partial condenser must be kept to a minimum. The relative volatility of methane and ethylene is fortunately high, approximately 5 : 1 throughout most of the column, so that only a few plates are required above the feed tray. However, in order to meet the low methane content required in most modern plants for the demethanizer bottoms, considerably more trays are required in the stripping section. At very low methane concentrations, the relative volatility of the key component decreases, thus making the separation more difficult, so that substantially complete demethanization is not practical. In addition a higher degree of stripping requires an increase in low level refrigeration for producing reflux, with a corresponding increase in operating cost. The molal latent heat of vaporization in the stripping section is not constant, so that the operating lines on the McCabe-Thiele diagram are not straight. Therefore a tray-to-tray calculation is desirable for final design purposes.

The amount of ethylene lost in the column overheads is primarily a function of the feed composition and the tower-top pressure and temperature rather than of the reflux ratio or number of plates. The large amounts of hydrogen in the overhead stream entails some loss of ethylene and ethane in order to satisfy dewpoint requirements. The greater the amount of hydrogen and inert gases the greater the loss of ethylene for comparable condensing conditions. In cases where a high ethylene recovery is required, an additional step is employed on the demethanizer residue gas.

In a number of units, the condenser and reflux drum are located above the column so that a gravity return of reflux to the column is possible. The specific gravity of the reflux is low, so that particular attention must be paid to the pressure drop through the piping and equipment if this system is to operate satisfactorily. More recently suitable pumps for this reflux service have become available and may be preferred.

The bottoms from the demethanizer flow to the de-ethanizer which operates under a pressure of approximately 400 lb./sq. in. abs. In this column ethylene, ethane, and small amounts of acetylene are taken overhead, the bottoms consisting of C_3 and heavier hydrocarbons. The separation in this case is relatively easy and the number of plates in

the column depends largely on the specifications to be met for loss of C_2s in the C_3 product stream. With a reflux ratio of approximately 0.9, the number of trays required will be 30 to 40. Conventional design procedures are satisfactory for this column.

The overhead from the de-ethanizer flows to the ethylene tower where the separation is made between ethylene and ethane. This column operates at approximately 275 lb./sq. in. abs., with a column-top temperature of approximately —20° F. The relative volatility of ethylene to ethane is low and decreases appreciably as the ethylene concentration rises. A large number of trays is therefore required for the separation. A typical column uses 60 trays with a reflux ratio between 3.5 and 5.0, although the values actually selected will depend upon the feed properties and the recovery and product properties that are specified. With a column of this type it is possible to obtain an ethylene product with a purity of approximately 98 per cent., which is adequate for many purposes.

In order to produce ethylene of 99.5 per cent. purity and above, as required for certain polythene processes, additional stages are required. The ethane content of the ethylene product is readily reduced to the requisite values by employing extra plates in the rectifying section of the ethylene tower. At the same time the ethylene recovery is maintained at a high value. Because of the reduced volatility of ethylene relative to ethane at these high purities, a large number of additional trays is required even at relatively high reflux ratios. For this reason it is frequently more convenient to provide the trays in a separate column, where possible, with the bottoms from the ethylene rectifier flowing as reflux to the ethylene tower. An ethylene rectifier functioning as shown will require approximately 50 trays and will operate under substantially the same pressure and temperature as the ethylene tower.

The methane content of the high-purity ethylene must also be reduced to a very low level. As pointed out earlier, complete removal of methane in the demethanizer is not feasible because of the increase in low-level refrigeration required in this column and the corresponding increase in operating cost, together with the very large number of trays required. A secondary demethanizer is therefore employed to reduce the methane to the required amount in the ethylene product. The overhead from the ethylene rectifier is pumped to the secondary demethanizer, and the small amount of methane and ethylene leaving this stripping column is recycled to the compression section for further ethylene recovery. Relatively few trays are required in the column, which operates at approximately 460 lb./sq. in. abs. and the overhead temperature at —30° F. Low level propylene refrigerant is used to produce the small amount of reflux needed. The final ethylene product is discharged from the bottom of the secondary demethanizer.

The C_3 and heavier material from the base of the de-ethanizer may also be fractionated into various components, particularly when substantial quantities are produced as in distillate cracking or in propane cracking. When ethane is the cracking feedstock, the amount of C_3 and heavier material is too small to justify further processing (table I) and is conveniently employed as fuel. The feed to the depropanizer consists of C_3 and heavier components from the de-ethanizer as well as stripped material recovered in the compression section. The column operates at approximately 210 lb./sq. in. abs., thus permitting the use of cooling water for condensing the overhead product and eliminating the need for refrigeration for this purpose.

For deep cracking of distillates, fouling of the high pressure compressor cylinders by unsaturated C_4 and heaver components is minimized by locating the depropanizer midway in the compression section. At the same time longer life of the desiccant is assured. With the depropanizer in this location, refrigeration has to be used to produce reflux at the operating pressure of approximately 240 lb./sq. in. abs. because of the presence of C_3 and lighter compounds. Additional dehydrators are required to prevent icing so that some increase in capital cost is inevitable, although this may be justified by a reduction in the maintenance charges.

While some degree of separation of propylene from propane is obtained in the depropanizer, the purity of the propylene product from a single column of this type is largely determined by the relative amounts of these hydrocarbons in the feed-gas. A purity of over 90 per cent. is usual, the exact figure depending on the cracking feedstock and the severity of cracking.

The C_4 and heavier material recovered from the depropanizer base is also often separated into various fractions. These operations are carried out at temperatures above atmospheric and are therefore outside the scope of this paper.

The majority of the fractionating columns require large numbers of trays. A number of special designs has therefore been developed to keep the columns within reasonable dimensions and at the same time minimize heat losses. Some of these designs eliminate the need for down-comers while at the same time ensuring good liquid and vapour distribution, permitting the use of smaller diameter columns. Close tray-spacing can be employed with such designs, to reduce not only the column height but also the supporting structure required for runback condensers and other equipment which may be located above the columns. Spacings of approximately 14 in. are commonly used with such trays.

Acetylene Removal

Acetylene removal facilities are an important feature of low temperature olefin recovery units and exert a significant influence on the design of the recovery unit. Two principal methods are currently practised on an industrial scale: solvent washing at low temperatures and selective hydrogenation.

The amount of acetylene that can be tolerated in the ethylene varies according to the use to which the ethylene is put. The major part of the acetylene produced in cracking operations appears in the ethylene product from the recovery plant, owing to the formation of azeotropes with both ethane and ethylene, and to the fact that when it is present in low concentration with ethylene and ethane, it behaves as the most volatile component. In mild distillate cracking the concentration of acetylene in the ethylene product is approximately 0.3 mol. per cent., while concentrations of from 5 to 25 p.p.m. are necessary for ethylene oxide or polythene production.

Solvent washing

Solvent washing with highly selective solvents such as acetone or dimethyl formamide can be used to obtain very low acetylene concentrations. With this process, the ethylene product stream is washed counter-currently with the solvent which is then flashed and stripped before returning to the absorber. The flashed gases are recycled for ethylene recovery and the acetylene, together with a small amount of ethylene, is vented from the system. Traces of solvent remaining in the ethylene product are removed by an activated charcoal absorption unit.

Selective hydrogenation

When selective hydrogenation is the preferred method of acetylene removal, the optimum location of the catalyst beds in the process has to be decided. This depends to some extent on which of the commercially available catalysts is selected.

Depropanization

If the propylene product is also required to be substantially

(*Concluded on page 266*)

SHOP REFRIGERATION NEWS

THE new premises of John Gardner (London) Ltd. in High Street, Kensington, London, provide a perfect example of how the modern supermarket is *built round* refrigeration services. Although that might appear to some to be an exaggerated statement, it is seen to be correct

REFRIGERATION SERVICES IN A LONDON SUPERMARKET

John Gardner (London) Ltd. open Superb Premises in Kensington

The 58-ft. Frigidaire two-tier Manhattan display case for the refrigerated display of dairy produce and frozen foods. The run at a temperature of 40° to 45°F. is for the presentation of dairy produce and the rest, at −5° to 0°F., for the display of frozen food. The shelf which runs along the entire length of the case is refrigerated.

SHOP REFRIGERATION NEWS

A 14 ft. Frigidaire Manhattan display case specially adapted for the self-selection of delicatessen by the addition of a high glass screen and surmounting shelf. Immediately behind this case is a small preparation area containing a 56 c.ft. storage cabinet and a 150 c.ft. fish cold room.

when one realizes that 215 ft. of low temperature and chiller cabinets is to be found on this unique retail selling floor which is predominantly a " refrigerated section."

The total area covered by the supermarket is 18,000 sq. ft. Of this, 8,000 ft. is occupied by selling space, the remainder by the meat and provision preparation rooms and office and storage space, though 1,800 sq. ft. in the basement has been set aside for future development. More space, therefore, is devoted to preparation and administration than to actual selling, and the refrigeration plant below stairs is very extensive.

This complete refrigeration equipment has been provided by Frigidaire Division of General Motors Ltd. and is believed to be the most extensive yet installed in a supermarket in this country ; it has been supplied and installed by Haynes & Orengo Ltd., of Peckham, Frigidaire distributors for south-east London.

In addition to the 215 ft. of refrigerated display there are seven cold stores, one freezer room and an air-conditioning plant for maintaining constant temperatures throughout the year in the large preparation area.

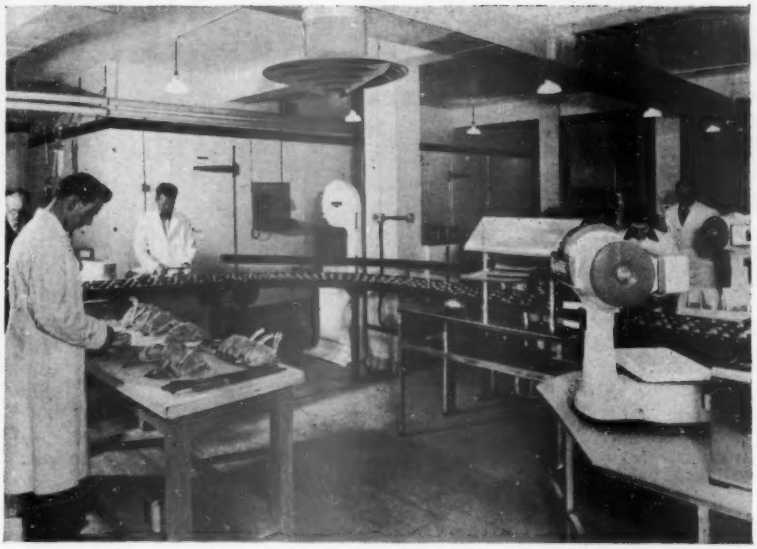
Haynes and Orengo have done a wonderful job here, for every section of the installation is something of a show-piece.

Perhaps the greatest problem with which they were faced was the need to eliminate noise from the equipment ; that is not to say that any of the plant was inherently noisy in operation but above the shop are luxury flats and it was laid down that 40 decibels must be the maximum noise level. That this limit has been comfortably achieved speaks volumes for the designers and installers. All of the 25 refrigeration units have been mounted on Ava vibro-insulators while fans and pumps have been chosen for their quietness—and efficiency. The Heenan-Marley water-cooled condenser in the basement handles a big job without fuss. As it pulls air through the basement it provides a measure of ventilation therefor.

The layout of the machine room (see page 264) is an engineer's dream and savours of the best shipboard practice. All copper piping (and there is 7,000 ft. of it comprising the refrigeration lines) has been boxed up in Mainstay insulated conduits, giving it a most business-like appearance. The lines hooked to the compressors have been sweated together and treated with aluminium paint.

A feature of the installation is that the refrigerated cabinets incorporate a new air-flow principle that defeats " spill-over " ; they incorporate, in fact, a " fan-assisted air chamber " and a 6° F. differential is maintained between inlet and outlet temperatures of the air traversing the produce.

One of the principal units in the refrigerated



SHOP REFRIGERATION NEWS

A view of some of the Frigidaire cold rooms which have been built into the walls of the lower floor preparation room. Three holding cold stores, for meat, poultry and provisions, are situated in this area, together with a pre-packed meat locker designed to hold 80 meat trays ready for despatch to the sales area as required. The preparation area is also air-conditioned to maintain a mean temperature of 65° F. throughout the year.

display is a 58-ft. two-tier run in the latest Frigidaire standard Manhattan style cabinets with panels in stardust yellow and trims in stainless steel. The run is cooled in five sections. The first 24 ft. has been designed to hold dairy produce and provisions at a temperature of 40° to 45° F. Beyond this is a 10-ft. section designed for conversion to frozen food at a later date but at present set to operate at 40° to 45°F. for bacon display. A 24-ft. frozen food section maintained at –5° to 0°F. completes the continuous display. Mounted over the entire run is a 58-ft. refrigerated shelf cooled in two sections for the display of bacon and allied products.

Along the far right-hand wall of the store are two 30-ft. continuous runs of cabinets for fresh meat and poultry. These cabinets, like the remainder of the cabinets in the store, are panelled in stardust blue. The whole of the 60 ft. is maintained at a temperature of 28° to 32° F. In addition to this run, an adjacent 10-ft. island site cabinet set to maintain a temperature of 40° to 45° F. is to be used for the display of cooked meats.

In the fish section service is to be maintained on self-selection lines with attendant assistants. For this purpose a 12-ft. fish display case, fitted with a high glass screen, surmounting shelf and special scale shelves, has been installed. A similar 14-ft. display case for delicatessens has been placed in a nearby position. Serving both departments is a small storage and preparation area containing a 13-ft. delicatessen storage cabinet of 56 c.ft. capacity and a fish cold room of 150 c.ft.

Another view of the food preparation and prepackaging area.

There is also a block-ice maker and ice crusher suitable for supplying crushed ice for use in the store and also for supplying small packs of ice for the public ; this produces ice in 8 to 28 lb. moulds and will make this amount twice a day.

In the basement there are seven cold stores, all finished in white stove-enamelled aluminium and, internally, in stipple-glazed asbestos.

All are of sectional construction and comprise the following :—

1,190 c.ft. meat cold room operating at a temperature of 32° to 34°F. ;

980 c.ft. provisions cold room operating at a temperature of 38° to 42° F. ;

200 c.ft. poultry cold room operating at a temperature of 32° to 34° F. ;

165 c.ft. pre-packed meat locker designed to hold pre-packed meat in 80 pressed aluminium trays carried on angle runners. Access to the trays is made by eight doors in the front of the cabinet ;

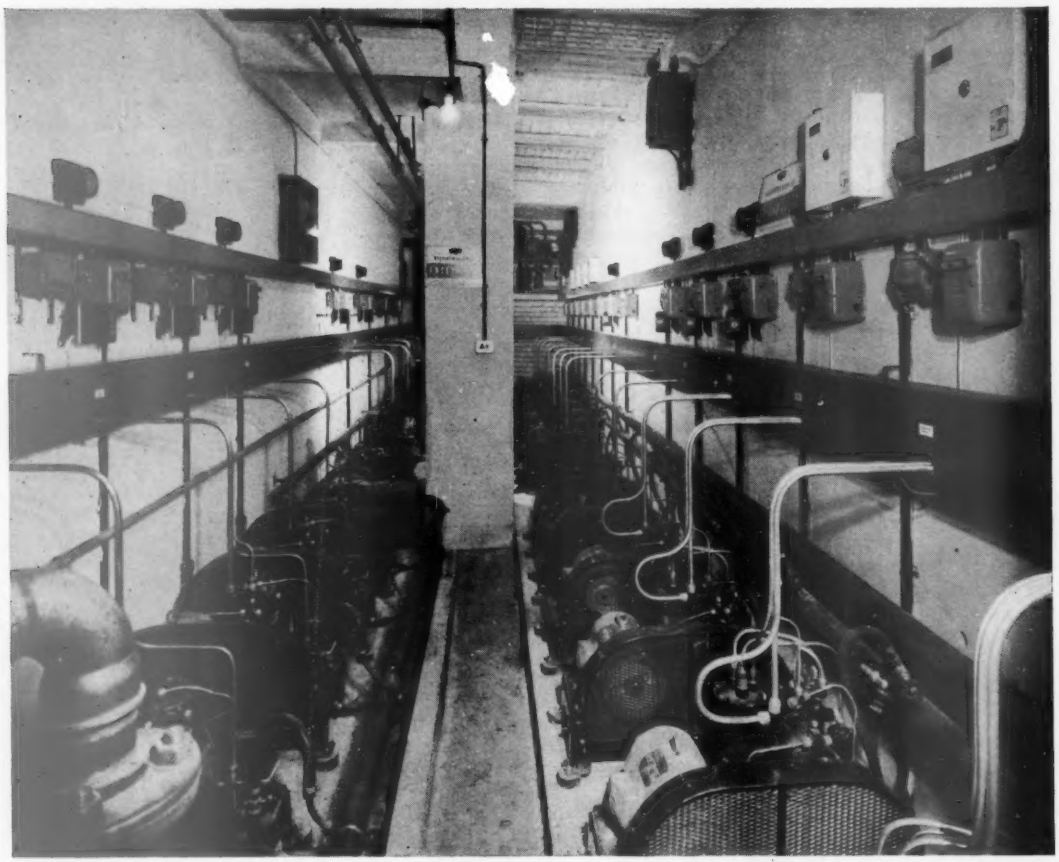
540 c.ft. freezer room to operate at temperatures of –5° to 0° F. ;

610 c.ft. dairy cold room to operate at temperatures of 38° to 42° F. ;

500 c.ft. fruit and vegetab'e cold room maintained at a temperature of 40° to 45°F.

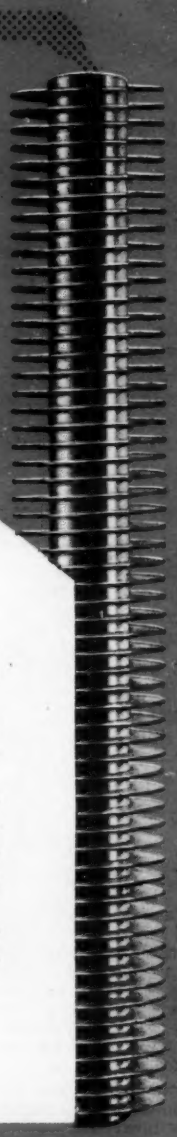
The meat, provisions, poultry and pre-packed meat cold stores are all contained within an enclosed food preparation area. This has been air-conditioned to maintain a mean temperature of 65° F. After boning and preparation, meats are

A view of the compressor house which contains the 24 Frigidaire water-cooled units, electrical controls and "Frostmaster" automatic defrosting equipment. All the equipment has been installed by Haynes & Orengo Ltd., Frigidaire distributors for South East London, and a most business-like job they have made of it.



SG

. . . the things we do!

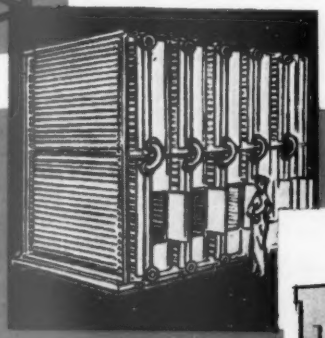


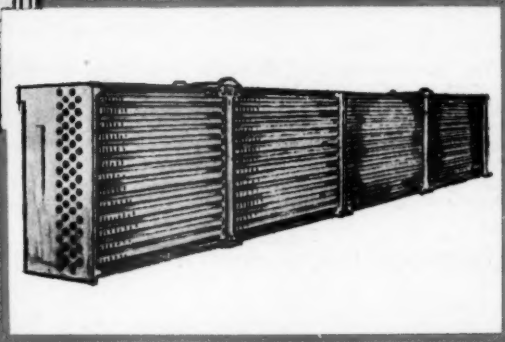
Too great a variety to be given in detail here but, generally, our business embraces the design and manufacture of all types of Heat Transfer apparatus. We are specialists in "Specials".

From our factory at Pulborough leaves a constant stream of Condensers, Heaters, Coolers, Evaporators, Exchangers, each designed to meet a special requirement which could not be met by a standard article.

If you have a problem in Heat Transfer our technical advice and the facilities of our factory are at your service—you have only to ask. If your design problem is already solved we are still happy to manufacture for you.

Or, if you only need Gilled Tubing, send for our catalogue. In it you will find the most comprehensive range available.





SPIRO-GILLS LTD

Head Office and Works:
LONDON ROAD, PULBOROUGH, SUSSEX
Telephone: Pulborough 2401/5

SHOP REFRIGERATION NEWS

loaded into trays which are stacked in the lockers mentioned and sent by lift to the selling floor above on to which they are wheeled in the same trolley.

The food preparation rooms have been specially designed and incorporate air-conditioning and a comprehensive system of lifts and conveyor belts, installed respectively by W. J. Furse Ltd. of Nottingham and Manufacturers Equipment Co. (Rapistan) of Hull. These preparation rooms are the result of considerable research and study. The equipment was designed in co-operation with John Gardner's by J. Cobden Ltd., and manufactured by them.

Beyond this area is the plant room housing the 24 Frigidaire water-cooled condensing units and the electrical control and automatic defrosting equipment; these are pictured on page 264 of this issue.

The whole of the refrigeration equipment in the store is entirely automatic and all condensate and defrosting water is carried away through a piped main drainage system.

RECOVERY OF OLEFINS

(*Continued from page* 256)

free of acetylenes, it is generally desirable to treat the whole C_3 and lighter fraction at one time. This can be conveniently achieved by installing a depropanizer in the compression section of the unit as outlined previously and treating the whole overhead gas from this column. The hydrogen required for acetylene hydrogenation is thus already available in the gas mixture, and polymers formed during the reaction are removed subsequently by the fractionation system.

If only the ethylene is required to be acetylene free, the removal unit is preferably sited so as to process the ethylene-tower overhead stream. The hydrogen required is obtained by treating a small portion of the recovery unit tail-gas stream. Excess hydrogen and polymer are removed in the ethylene rectifier and secondary demethanizer or where these columns are not installed, in a small ethylene clean-up column.

Catalyst regeneration

The hydrogenation catalysts require periodic regeneration in order to maintain high activity. This step may require superheated steam-stripping, followed by hot-air treating, the exact procedure depending on the catalyst composition. Normally a separate reactivation furnace and multiple reactors are installed so that one reactor is undergoing regeneration while the others are on stream. By this means continuous operation of the hydrogenation unit is ensured.

Refrigeration

Heat-recovery from the various process streams is practised to a considerable extent in the recovery systems discussed in this paper but this is not pursued to the extent of affecting operating flexibility. Although close integration reduces the power consumption of the refrigeration system, this is at the expense of operating flexibility, and an upset in one section of the plant is likely to spread its effect through other sections, causing loss of production.

Ethylene and propylene or propane have been adopted as refrigerants in the olefin recovery units because of their low cost and the ease of replacing losses with the product streams from the plants. As a result, only the initial charge of propylene or propane refrigerant has to be provided from outside. The suction pressures for the lowest stage of compression are preferably maintained at slightly above atmospheric pressure, thereby limiting the lowest operating temperatures obtainable to approximately —145° F. for the ethylene refrigerant and —45° F. for the propane-propylene refrigerant. A cascade system is employed, since the critical temperature of ethylene is 50° F. The allocation of duties to the two cycles is indicated in table III.

This allocation of duties is based on using two-stage flashing of propylene. While the use of more flashing stages increases the efficiency of the system, it can only be achieved at the expense of additional equipment, so that for economic reasons it is rarely justified. Refrigerant vapours are

TABLE III

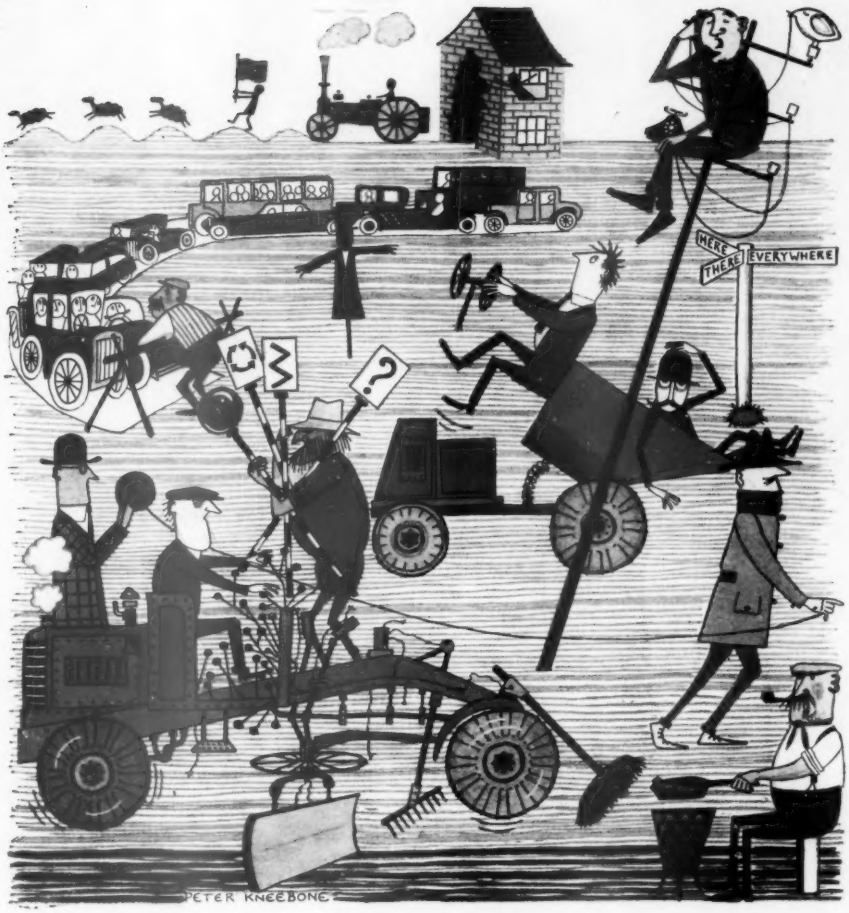
DUTIES OF CYCLES OF CASCADE REFRIGERATION

	Level.	
Ethylene	High	Demethanizer precooler.
	Low	Demethanizer condenser.
Propylene	High	Dehydrator feed precooler.
	Medium	De-ethanizer condenser.
	Medium	Demethanizer precooler.
	Low	Demethanizer precooler.
	Low	Ethylene refrigerant condenser.
	Low	Ethylene tower reflux.
	Low	Ethylene rectifier reflux.
	Low	Secondary de-methanizer reflux.

condensed where possible in exchangers and reboilers for increased economy.

In this modern propylene system, propylene vapour from the low level of refrigeration is compressed to approximately 250 lb./sq. in. abs., at which pressure condensation with cooling water at normal temperatures is possible. After subcooling the condensed propylene with process streams, the liquid flows to the high-level exchangers and to the first stage flash-drum. Part of the vapour from the flash-drum is used for reboiling while the remainder returns to the high pressure stage of the compressor for recycling. Liquid from the flash-drum flows to the medium level exchangers and to the second stage flash-drum.

The 1958 edition "Physical properties of synthetic organic chemicals" booklet is available from the chemicals department, Union Carbide International Company, division of Union Carbide Corporation. Included in this handy 28-page booklet is the latest physical property data of more than 350 organic chemicals. An alphabetical index is included for the convenience of the user. Fifty new chemicals, introduced by Union Carbide since the previous edition, are featured. For easy reference, other chemicals are arranged by related chemical groups with condensed application data. Complimentary copies of the booklet (RF-6136) are available on request from the Chemicals Department, Union Carbide International Company, 30 East 42nd Street, New York 17, N.Y., U.S.A.



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liquid from the second drum flows to the low-level exchangers. The vapours from both medium and low levels of refrigeration are then recompressed.

The ethylene system follows similar lines except that because of the low critical temperature of ethylene the compressed gas is condensed with propylene.

A single compressor can be used for the sake of simplicity, although in practice, a number of units operating in parallel may be employed. By this means, fluctuations in the refrigerant load are readily handled and at the same time routine maintenance of the compressors can be carried out without the need for interrupting the operation of the low temperature fractionation system. When reciprocating compressors are employed, the use of adjustable pocket-valves permits considerable variation in the refrigerant flow without upsetting the pressures and temperatures in the refrigerant exchangers. In the case of centrifugal compressors a variable recycle control is frequently employed although when a steam turbine drive is used, this may not be required.

IIR NEWS

with particular reference to the Bulletin of the International Institute of Refrigeration. No. 6, Vol. 37, 1957

By DR. EZER GRIFFITHS, O.B.E., F.R.S., President of the General Conference, I.I.R.

THE bulletin of the I.I.R. supplies information covering the whole field of refrigeration.

Commission 1 plans to meet at Deft in June 1958. Joint meetings of commissions 2 and 7 will take place in September at Prague. Their programme covers the testing of insulated refrigerated and mechanically cooled vehicles ; the accumulation of moisture in the insulation of transport vehicles ; the properties of insulation such as dilatation and combustibility ; standardization of methods of test ; measurement of low air speeds.

Commissions 3, 4 and 5 plan to meet in Moscow in September. Topics for discussion will be automation in industrial refrigerating plants ; freezing of fish ; guide for cold storage.

Commission 6 will meet at Karlsruhe and among other topics will consider the applications of refrigeration to the chemical industries.

Commission 9 will meet in September in Paris and the programme will be announced later.

In the abstracts under the heading " heat transmission " there is one from the U.S.S.R. on " heat exchange and boiling of liquids in annular spaces."

An abstract from the U.S.A. deals with " Heat transfer rates from heated horizontal tubes to trichloromonofluoromethane."

A German paper is entitled " Heat and mass transfer in humid gases " while a Russian paper discusses " Heat and mass-exchange in an air cooler with spiral fins."

The section of the bulletin concerned with the production and distribution of cold has a number of abstracts relating to refrigerants such as " The story of ' Freon ' refrigerants " and " A comparison of refrigerants when used in vapour compression cycles over an extended temperature range."

A paper from the Scientific Research Institute of the Refrigerating Industry, U.S.S.R., deals with " Tests of an internal-circulation ammonia cooling coil." " Simple selection method for capillaries " is the subject of a paper from the U.S.A. " Absorption refrigerating plants " is the topic of an 11 page paper.

Dealing with auxiliary equipment there is an abstract of a paper on stopping deterioration in recirculating cooling water systems and one on automatic defrost utilizing a latent heat source.

Under " Insulation," peat slabs and the modern expanded materials are referred to, as also is rock wool.

There is a long abstract entitled " Some observations on the coefficient of change of air and renewing of air in a cold room."

A number of abstracts mention cold storage warehouses. In one an account is given of the use of ice-coated canvas sheets to reduce meat shrinkage. Relative humidity of 79 to 98 per cent. instead of the usual 85 to 90 per cent. is claimed.

A new radial plate freezer is described in another abstract.

Under the heading " Air-conditioning and heat pumps " there are a number of abstracts ; one relates to hospital needs, another to a church, and one to newspaper plant.

It is interesting to note that a screen of air flowing downwards at low velocity from the grilles of a distribution system in the ceiling is replacing the usual type of door.

Car and truck cooling is making rapid progress in the U.S.A. The number of units is expected to reach the million mark by 1960.

In the section devoted to " Containers : Packing," there is an abstract dealing with moisture absorption by some packaging materials at sub-freezing temperatures. Another abstract is entitled " Storage in polyethylene lined containers."

Frozen foods are the subject of several abstracts. One tackles thawing and refreezing another storage in display cabinets and another the gauging of frozen food temperature.

A lengthy paper concerns itself with methods of improving food preservation in home refrigerators.

Other abstracts relating to frozen food refer to the application of antioxidants in freezing stone fruits and time temperature tolerance of frozen foods.

As regards vegetables, the storage of potatoes and mushrooms is dealt with.

In the section relating to refrigeration as regards animals and animal products for food, there is a lengthy abstract entitled " Mechanics of freezing in living cells and tissues."

Two abstracts relate to recent developments " Radiation preservation of cured meats " and " Microwave energy in freeze-drying procedures."

Poultry freezing is the subject matter of several abstracts.

Fish also receives consideration ; abstracts deal with the influence of freezing-rate, quality changes during freezing and factors affecting the shelf life of frozen fish.

Medical applications of refrigeration are adequately covered, two of the abstracts mention freeze-dried bone grafts and an experimental study on bone grafts.

Hypothermia by venous cooling is the subject of one of the abstracts.

The bulletin contains a number of abstracts relating to statistical information for various countries. From the foregoing it will be realized that the abstracts range over a large field.

In an appendix there is a paper describing the training in the U.S.S.R. of engineers for food industries using refrigeration techniques ; this supplements the series of

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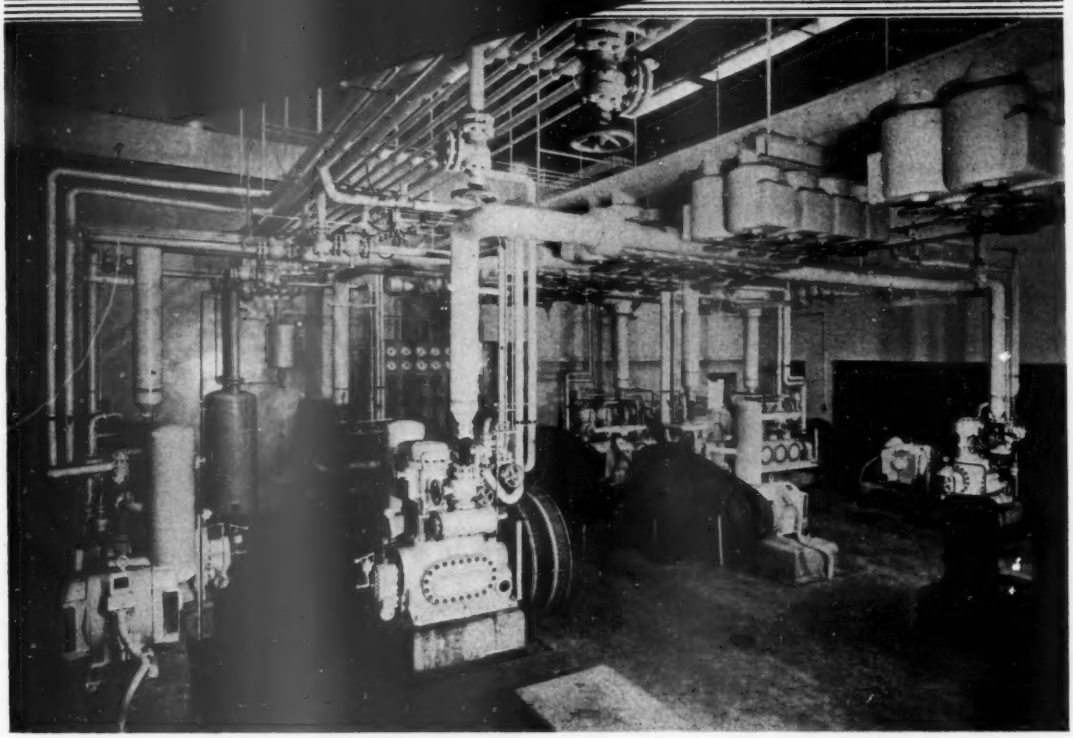

The photograph above shows part of the refrigeration engine room in the new factory for Messrs. Kraft Foods Ltd., at Kirkby near Liverpool.

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papers on the training of engineers and technicians in refrigeration given in Baden-Baden in 1953 and already published in an annex (1954–No. 3) to the bulletin.

The bibliography indicates the contents of a number of new books mostly relating to refrigeration and air-conditioning.

It is announced that the price of the bulletins has been increased as from January 1, 1958. The new rates are :—

Members Countries : English pounds 3, U.S.A. dollars 8.5.

Non-member Countries: English pounds 4, U.S.A. dollars 12, or the equivalent in any usual currency.

*Further details from the hon. secretary in the U.K., I.I.R., Maclaren House, Great Suffolk Street, London, S.E.*1.

New Refrigerator for the Smaller Kitchen

AN attractive addition to the range of British domestic refrigerators announced for the new season is the " English Electric " model 7503 table-top refrigerator. It is of a design which has unusually slim external dimensions and the maximum internal storage space for its measured capacity. The model 7503 refrigerator is 36 in. high and only 20 in. wide by 22½ in. deep, giving a capacity of 3.6 c.ft. and a shelf area of 6.7 sq. ft. This has been achieved by using a new space-saving low-consumption sealed-compressor unit, providing three movable rod shelves in the food compartment which slide in and out on runners at five different levels, a roomy evaporator and chill tray, and deep shelves on the inner panel of the full-length door. The table top is vitreous enamelled so that it may be used as a working surface, and is swept up at the back to prevent anything falling down behind.

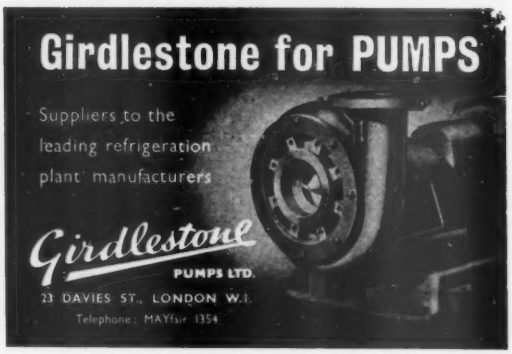
The cabinet of the refrigerator is steel, welded construction, with vitreous top and stoved synthetic enamel body. The food compartment is vacuum formed, one piece, high impact polystyrene with built-in shelf supports. A longitudinal aluminium trim gives a neat finish between the food compartment and the external shell. The door is a full-length, box-form, steel pressing, rust-proof treated and sealed by a specially developed vinyl plastic gasket. It has nylon bearing hinges and opens within its own width so that it may be fitted flush against neighbouring appliances or kitchen units. The inner door panel, which is also of vacuum formed, high impact polystyrene, carries a rack for six large eggs, a shelf for small packets or bottles, a full-width dairy keeper with drop-down door and a butter dish, and a deep shelf taking four full-size wine bottles upright. A new type of " pull-open " latch is used. This long-life latch has no mechanical connexion

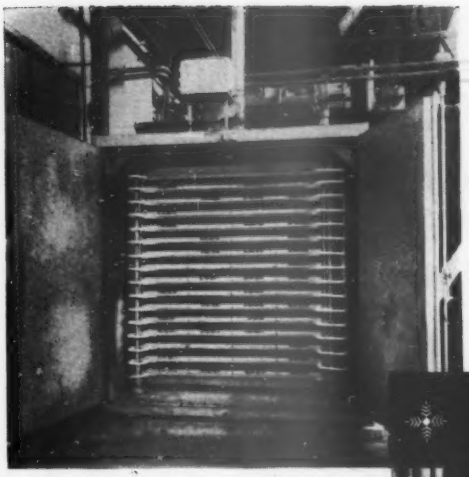
The new English Electric table-top refrigerator. With a vitreous enamelled table top, and compact external dimensions of 36 in. high by 20 in. wide by 22½ in. deep, the new "English Electric" Model 7503 refrigerator has a capacity of 3.6 c.ft. and 6.7 sq. ft. shelf area

with the door handle, and the handle itself is a robust, fixed, chromium-plated die-casting.

Fitments

Interior fitments include a roll-bonded aluminium evaporator, of 0.3 c.ft. capacity, finished in durable lacquer, and with a moulded polystyrene self-closing door. A detachable rod divider-shelf





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Lightfoot 15 stage Froster installed for Messrs. Macrae (D.A.) Ltd., Wholesale Fish Merchants & Curers, Hull.

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separates a 16-cube moulded polythene ice tray from packet foods stored in the evaporator, and there is also a moulded polystyrene chill tray for flat meats which acts as a drip tray during defrosting.

Unit

The refrigerator unit is hermetically sealed and has a new space-saving, low-consumption, reciprocating compressor, driven by a 1/12-h.p. single-phase squirrel cage, induction motor with automatic thermal overload protection. Temperature is controlled by a variable thermostat mounted in an easy-to-reach position in the roof of the food compartment at centre front. The compressor and motor are internally sprung to give very quiet running. For sub-tropical climates a 1/9-h.p. motor is fitted. Voltage ranges available are A.C. 210/240 at 50 cycles ; 110 volts at 50 cycles, or 115 volts at 60 cycles. The unit is interference free with radio and television and carries the normal five-year guarantee. The refrigerant is Arcton-6.

The new 7503 is available in pale champagne or white exterior finish, with a paradise blue food compartment and polythene-coated steel-rod shelves, trims of kingfisher blue and copper-coloured aluminium shelf guards. Retail price is 66 guineas, tax paid.

Application of Refrigerated Sea-water Fish Holding to a Halibut Fishing Vessel

FOLLOWING work by the Technological Station, Vancouver, of the Fisheries Research Board of Canada on the fish packer *J.R.D.* (Progress report no. 104, pp. 3-6, November, 1955), it was decided to investigate the application of refrigerated sea water to halibut fishing where the long holding time required because of the length of of the trip dictates some improvement in holding methods. A halibut trip consists of 12 days average fishing time plus 1 to 5 days returning to port, plus 1 to 5 days in port prior to unloading, it is stated in the latest report, no. 108.

The vessel selected for this experiment was the *Silver Viking* which was being built, thus making possible the incorporation of the system into her original construction. Since this vessel was designed as a combination salmon seiner and halibut long-liner, it also made possible a study of the application of refrigerated sea-water holding to salmon seining. The vessel is a typical Pacific salmon seiner of wood construction, 78 ft. long with a 22-ft. beam. Six tanks were installed in her hold, three on either side of the shaft. The tanks are constructed of 3/16-in. steel plate and surfaces unsupported by the hold lining are stiffened by 2½-in. angle irons toe-welded on 2-ft. centres. The inside surfaces are coated with an Epoxy resin coating to resist corrosion. Two inches of cork insulation were applied to the external surfaces.

Cooling coils, located in each tank, are made up of 250 ft. of ¾-in. O.D. steel tubing, the assembled coil being hot-dip galvanized. The coils are contained in closed compartments along the inboard tank sides. Circulation of the chilled sea water is provided through this compartment by a separate circulating pump for each tank. Refrigeration to these coils is supplied by two compressors, one for the three port tanks and one for the three starboard.

To augment this refrigeration system there is a completely separate one comprising a shell and tube chiller, circulating pump and refrigerant compressor. This system is used to speed up the initial cooling of any one tank but also serves as a stand-by system in event of failure of the tank coil system.

All pumps and compressors are electrically driven. Power is supplied by two diesel-driven

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alternating-current generators. These generators are the 120-208-volt type which supply either single phase 120-volt current for the small motors and ship lighting or 208-volt 3-phase power for the larger motors.

The *Silver Viking* engaged in salmon seining in July and August. Round sockeye and chum salmon were brought to port in excellent condition after the week's fishing, and sockeye, after further sea-water storage to a total holding time of 14 days, was still judged to be excellent. Some difficulty was encountered with the loss of scales and skin pigment of round coho and jack spring. The dressing of all fish of these species overcame this trouble whereas the dressing of sample individuals did not. These observations gave support to a theory that the damage was caused by a destructive enzyme disgorged with the stomach contents of these actively feeding fish. Belief that this loss of scale and skin pigment was caused by the motion of fish in the tanks seems unlikely since this did not occur in loads composed entirely of non-feeding fish or dressed fish.

The use of this equipment in salmon seining showed many advantages which may in the future be of value. First was the ship's ability to operate in areas remote from canneries or packers. Second was that no time was lost in the daily delivery of fish. Third was the much increased value of some types of fish when delivered by the fishing vessel itself directly to port. This was emphasized by a week's catch of chum salmon which was delivered to the fresh fish market. The tank trunks on deck hindered the crew during salmon-seining operations while handling the net and brailing fish aboard. However, simple alterations have been made which eliminate this difficulty.

The vessel engaged in halibut fishing in the September opening of halibut in area 2. Some 36,000 lb. were caught and sold 8 to 15 days after catching. These fish were in fine marketable condition, and samples held in a tank at the Pacific Research Station at Vancouver to a total time of 29 days were still in good condition. Many advantages were demonstrated by this trip. Foremost was that halibut could be held beyond any period practical in fishing. Elimination of icing of fish increased the effectiveness of the crew, which would mean larger catches in periods of good fishing. The equipment in no way appeared to hinder the handling of gear or fish.

Of special interest in this project was the chiller which as explained previously was designed to assist in the initial cooling of the sea water and to a limited extent to act as an emergency system. However, since the first purpose was of greatest importance, the chiller was designed with a close tube spacing permitting high water velocity and hence a high heat transfer from the tubes. Thus a chiller of small outside dimensions which could be easily installed or dismantled for maintenance could be made. It was expected that this design would not permit attaining low temperatures, because of ice formation on the tubes. This, however, was not the case as it has proven possible to cool water to 30° F. with the chiller.

The chiller has an outer shell of 6-in. Kralastic pipe. The use of this material serves three purposes: it reduces the weight of the chiller, eliminates corrosion of the shell, and provides sufficient elasticity to prevent rupture by freeze-up. The shell contains 240 ft. of $\frac{5}{8}$-in. O.D. copper refrigerant tubing arranged for dry refrigerant expansion in six parallel circuits of four horizontal runs of tubing extending the length of the shell. Twenty semi-circular baffles direct flow of sea water across the tubes. All refrigerant connexions are on one end to permit easy removal of the shell for maintenance.

The success of this chiller has altered Canadian opinions on design of refrigerated sea-water equipment. With such small chillers being effective they can be relied on entirely for the cooling without employing tank coils. This change would in turn affect other components of the system. For example, on such an installation as the *Silver Viking's* the same flexibility and guarantee against failure could be obtained with two compressors and two chillers as are now afforded by three compressors. Similarly, two compressors could be driven mechanically as in the *J.R.D.* installation described in the earlier article mentioned, whereas a third compressor warrants electrical generating and driving. The removal of coils from the tanks would simplify maintenance and permit the use of cheaper corrosion-resistant coatings.

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